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40 Years 1948-1988

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PREFACE

This study evaluates a hospital rate-setting system—based on diagnosis related groups—adopted by the State of New Jersey and analyzes the responses of hospitals in the early years of the program. The work reported here was supported by the Health Care Financing Administration, Office of Research and Demonstrations, and was conducted as part of the research program of the RAND/UCLA Center for Health Care Financing Policy Research. It should be of interest to health care policymakers and managers who are concerned with hospital reimbursement systems and with programs to contain health care costs.

SUMMARY

With enactment of the Medicare Prospective Payment System (PPS) in 1983, hospitals nationwide found themselves subject to a prospective reimbursement system that paid hospitals on the basis of a case-mix classification system called Diagnosis Related Groups (DRGs). Until then, such a system had been tried in only a single state—New Jersey—which implemented its all-payor, DRG-based prospective payment system in 1980. This report contains an empirical analysis of the effects of the introduction of DRGs on hospital behavior in New Jersey.

Under the New Jersey payment system, hospitals are paid a fixed amount, determined in advance, for each inpatient inlier admission. The amount is determined by each patient's DRG. Each hospital has its own set of payment rates, and within each hospital, payment rates are nearly equal for all payors.

The amount paid to a hospital for a DRG depends on three factors: the hospital's average cost for the DRG, the statewide average cost for the DRG (computed separately for major, minor, and nonteaching hospitals), and a hospital-specific add-on to cover indirect costs. As part of the hospital-specific add-on, each hospital's DRG rate also includes an amount to cover the costs of uncompensated care (charity care and bad debt). Approximately one-quarter of all admissions are defined as outliers, for which hospitals are paid their full, reasonable costs.

By paying a fixed amount per admission, the New Jersey DRG-based rate-setting system creates an incentive for hospitals to reduce average cost per admission. Hospitals may choose from alternative strategies to achieve this goal.

- Hospitals can lower their costs of providing a given amount of care by increasing their efficiency or paying less for inputs.
- Hospitals can reduce the amount of care provided per admission by shifting some of the care to outpatient services, skimping on care (e.g., discharging patients prematurely), or providing the care over more than one admission.
- Hospitals can attempt to select patients who are likely to be less expensive than the average patient.

Alternatively, hospitals may attempt to exploit the structure of the DRG-based payment systems by incorrectly classifying patients into higher paying DRGs (referred to as DRG creep), or by extending the

length of stay (LOS) of some patients to qualify them as long LOS outliers.

The New Jersey experience with an all-payor DRG rate-setting system provides a good opportunity to evaluate hospital responses to the new incentive structure. In particular, our study explores the following questions:

- Do hospitals respond to the new economic incentives by lowering average cost per admission? Are overall cost savings achieved?
- Are government-sponsored patients, privately insured patients, and self-pay patients equally profitable for hospitals? If not, do some hospitals succeed in discouraging admissions of the less profitable patients?
- Do patients admitted under an emergency or urgent status represent an identifiable group whose costs are systematically higher than patients admitted on an elective basis after controlling for DRG?

Our analyses show that the New Jersey all-payor DRG rate-setting system has been successful in improving intermediate measures of hospital efficiency but unsuccessful in controlling hospital cost inflation, measured in terms of either total hospital expenses or net revenues. The explanation for this paradox lies in the overall increase in total admissions.

- Average cost per admission and per adjusted admission (adjusted for the number of outpatient visits) fell by an estimated 4.7 percent and 6.2 percent, respectively. These reductions were achieved by reductions in both average LOS and average cost per patient day. However, there was no statistically significant decline in total expenses because of a 5.3 percent increase in total adjusted admissions.
- Although hospitals experienced a 3.4 percent reduction in net revenue per adjusted admission, there was no decline in total net revenue, because of the increase in total adjusted admissions.

The economic incentives imposed by the DRG rate-setting system did not produce a uniform response from hospitals. Hospitals behaved differently depending on their expected financial position under the system. Hospitals expecting a loss, based on pre-DRG experience, acted more strongly to increase admissions, decrease average LOS, and decrease labor inputs and labor costs than hospitals expecting a surplus.

- Hospitals expecting a loss under DRGs increased admissions by 7.5 percent. They reduced expense per patient day by 3.1 percent and average LOS by 5.2 percent, reducing expense per admission by 8.1 percent. The lower expense per day was due in part to reductions in labor inputs and costs: Labor expense per adjusted admission fell by 8.7 percent and expense per FTE declined by 3.5 percent.
- Hospitals expecting a surplus under DRGs increased admissions by 4.4 percent. There was no change in their expense per admission, since a 2.6 percent reduction in average LOS was offset by a 2.1 percent increase in their expense per patient day. These hospitals were not successful in controlling the cost of their labor inputs: Labor expense per adjusted admission and labor expense per FTE both rose by 3.7 percent.

If hospitals are able to predict which patient groups are more costly to treat, they may be reluctant to admit such patients. If some hospitals are successful in limiting admissions of these patient groups in selected DRGs, and these patients are diverted to other "last resort" hospitals, we would expect that the distribution of these patients across hospitals would be more concentrated in 1982 compared to 1979. Using 1979 discharge data, our analyses showed that as hospitals were being phased onto the all-payor system, they could expect Medicare patients to be less profitable than privately insured patients. The Medicare average LOS was 13.9 percent longer and the cost per admission was 11.4 percent greater, even after limiting the analysis to inliers and controlling for hospital teaching status and DRG classification. We identified a subset of DRGs that demonstrated the greatest potential gain from limiting Medicare patient admissions (dumping). Our results showed no evidence of differential treatment of Medicare patients in the selected subset of DRGs. These Medicare patients were admitted by a larger, not a smaller, number of hospitals in 1982 than 1979.

Our inability to observe dumping of Medicare patients at a statewide level may indicate that hospitals have not discriminated against this group of patients, at least in those DRGs in which they were the least profitable. Or it may be that our analysis, which focused on payor class, missed finding differential treatment based on other patient characteristics (e.g., severity of illness).

The presence of systematic variation in resource use not captured by DRGs, and distributed unevenly across hospitals, challenges the fairness of PPS and threatens equitable patient access. Using inpatient

discharge data from 1982, we tested for systematic variation in resource use by elective and nonelective admission status.

- After controlling for DRG category and hospital teaching status, elective admissions were, on average, 18.0 percent less expensive than emergency and urgent admissions. Restricting the analysis to inliers, elective admissions were 6.5 percent cheaper.
- Inlier elective surgical admissions were 10.2 percent less expensive than emergency and urgent admissions, whereas inlier elective medical admissions were only 4.9 percent less expensive. For surgical admissions, the lower cost is largely due to shorter average LOS, but over half of the lower cost of elective medical DRGs is due to lower average cost per day.
- The effect of elective admission status varies widely among DRGs. For example, the cost differential ranges from 62 percent cheaper (DRG 317) to 68 percent more expensive (DRG 462) among medical DRGs.
- Because of the complex relationship between admission status and costs, a single adjustment factor for admission status does not improve the ability of the DRG system to explain hospital cost per admission.

Although our study provides useful insights into how hospitals may respond to the Medicare PPS program, two distinguishing features of the New Jersey experience must be considered when interpreting our results. First, the New Jersey system is an all-payor program, but in other states the DRG-based PPS applies only to the Medicare program and in some instances to the Medicaid program. Therefore, the ability of hospitals to circumvent regulatory control of payments in New Jersey is constrained by the all-payor feature of the program. Second, almost all hospitals in New Jersey are nonprofit institutions, whereas a significant percentage of the nation's hospitals are for-profit institutions. Nonprofit hospitals may respond differently to the PPS economic incentives than for-profit hospitals, especially when they do not face competition from for-profit institutions.

ACKNOWLEDGMENTS

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We would also like to thank the New Jersey Department of Health for providing data for this study, especially Faith Goldschmidt and Vince Yarmlack for their help in understanding and using data from New Jersey. Our thanks also go to Robert Knauf, one of the architects of the early New Jersey system, for his generosity in answering our many questions on the workings of the New Jersey DRG-based system.

We are particularly indebted to Cindy Mason, project officer, for her support and continued insight into the New Jersey system.

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I. INTRODUCTION

In an effort to control the increase in health care expenditures, while at the same time seeking to improve or at least maintain access to hospital services, several states enacted prospective hospital rate-setting systems in the 1970s and early 1980s. The various state programs each had in common the feature that hospitals are paid on the basis of rates that are set in advance, regardless of the costs of treating any individual patient.[1] Such prospective reimbursement systems shift part of the risk of cost increases from insurers to hospitals, thereby providing hospitals with an incentive to restrain increases in the costs of treating patients. The particular features of a state's program determine the potential for achieving the desired goals.

This report seeks to evaluate one state's system—New Jersey's—which was unique in that it elected to pay hospitals on the basis of (what was then) a newly created case-mix classification system, Diagnosis Related Groups or DRGs. Since 1980, when New Jersey adopted its hospital payment system as a demonstration project sponsored by the Health Care Financing Administration (HCFA), DRG-based hospital payment has been adopted nationally by the Medicare program eight state Medicaid programs, and a few Blue Cross/Blue Shield plans.

The present study evaluates the hospital rate-setting system adopted by New Jersey and analyzes the responses of hospitals in the early years of the program. Under the New Jersey system, hospitals are paid a fixed amount, determined in advance, for each inpatient inlier admission. The amount is determined by the patient's DRG. Each hospital has its own set of payment rates. However, within a hospital, payment rates are nearly equal for all payors.[2] Approximately one-quarter of all admissions are defined as outliers and are reimbursed on the basis of reasonable costs.

DRG-based prospective reimbursement systems provide hospitals with an economic incentive to lower costs or, at least, to restrain the increase in costs. Hospitals that are able to improve efficiency will benefit by increasing their net income. The questions of whether and how hospitals respond to the economic incentives provided by the New Jersey rate-setting program form the basis of our empirical analysis.

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[1]An exception is made for outlier patients if a state's program creates such a category.

[2]A small discount is provided to Blue Cross (6.18 percent), Medicare (2.66 percent), and Medicaid (2.65 percent) patients.

In Sec. III we explore hospital responses to the economic incentives of the DRG program. We examine the effect of the DRG payment system on hospital utilization, inputs, expenses, and revenues. Two questions are addressed. The first is whether hospitals respond to the economic incentives by lowering average cost per admission and whether overall cost savings are achieved. The second question asks whether all hospitals respond similarly to the economic incentives of the fixed price payment system. High-cost hospitals faced with losses may reduce costs, whereas low-cost hospitals faced with a surplus may decide either to spend it, thereby raising their costs, or to simply maintain costs at the same level.

An important aspect of an all-payor DRG-based prospective payment system is that the payment rates be equitable. In Sec. IV we investigate whether there are differences in hospital resource use and profitability by payor group. If such differences exist, we examine whether hospitals respond to these differences by selectively discouraging admissions of patients in higher-cost payor groups. Differences in average costs by payment source that remain after controlling for DRGs may pose two problems for an all-payor system, such as New Jersey's, which sets nearly uniform payment rates by payor: The first concerns the fairness of payments to hospitals; the second concerns access to hospital care by high-cost payor groups.

Hospitals serving a disproportionately small or large share of high-cost payor groups may experience financial gains or losses unrelated to the efficiency with which they provide services. If certain hospitals routinely treat patients who require more services than predicted by DRGs, the long-run financial viability of these hospitals will be threatened. Moreover, if hospitals seek to protect their financial standing by limiting admissions of patient groups who can be predicted to generate higher-than-average costs, such patient groups may have difficulties in obtaining hospital services.

In addition to payment source, we examine whether admission status is significant in explaining differences in hospital resource use. Section V explores whether patients admitted on an emergency or urgent basis use significantly more inpatient resources than elective patients after controlling for DRG. If a significant difference is found across all DRGs, we examine whether the relationship is the same for all DRGs or whether it is DRG-specific. Our analysis also investigates whether information on admission status could be incorporated into the payment system to improve its ability to explain variation in cost per admission.

II. BACKGROUND AND REVIEW OF THE LITERATURE

With Congressional passage of the Medicare Prospective Payment System (PPS) in 1983, the use of DRG-based, case-mix reimbursement systems received instantaneous national recognition. Because few hospitals escape the purview of the Medicare program, hospitals nationwide found themselves subject to a case-mix-based payment system that had, until then, been tried only in a demonstration project covering the 98 acute care hospitals in New Jersey. Since that time, eight states have adopted DRG-based reimbursement systems in their Medicaid programs. Continued interest by Congress and HCFA in refining the PPS indicates that the use of DRG-based reimbursement systems will persist.

Since New Jersey's DRG-based payment system is the oldest in the country, a systematic analysis of it may provide some insight into the likely effects of more recently adopted DRG-based reimbursement schemes. The purpose of this report is to provide the results of an empirical analysis of the effects of the introduction of DRGs on hospital behavior during the first three years of New Jersey's program.

HOSPITAL RATE SETTING IN NEW JERSEY

New Jersey has a long history of using rate setting to control hospital cost inflation. Table 2.1 summarizes the various approaches used from 1968 through 1980 when the DRG-based system was adopted. The initial attempt to control hospital rates in 1968 was voluntary. Fifteen hospitals submitted their budgets to an advisory committee appointed by the Commissioner of Insurance, which reviewed them and recommended rate ceilings for Blue Cross. Within three years, a law was passed that mandated participation of all hospitals in a budget review program. Under this program, the Hospital Research and Educational Trust, a subsidiary corporation of the New Jersey Hospital Association, collected data on hospital budgets and recommended per diem rate ceilings for Blue Cross and Medicaid.

In 1975, New Jersey adopted its first prospective rate-setting system, which established per diem rates as the basis of payment for the two payors—Blue Cross and Medicaid—that had been regulated in the previous payment system. The program, known as the Standard Hospital

Table 2.1

HISTORY OF HOSPITAL RATE SETTING IN NEW JERSEY

Year	Program Description	Hospitals Covered	Payors Covered	Rate-Setting Agency
1968	Voluntary Budget Review	15	Blue Cross	Advisory Committee
1971–74	Voluntary Budget Review	All	Blue Cross, Medicaid	Hospital Research and Educational Trust
1975–79	Per-Diem-Based Prospective Rate Setting	All	Blue Cross, Medicaid	New Jersey Department of Health
1980–present	DRG, Case-Based Prospective Rate Setting	26 (1980) 62 (1981) 98 (1982)	All	New Jersey Department of Health

Accounting and Rate Evaluation System (SHARE), covered all short-term, acute care hospitals in the state and was administered by the New Jersey Department of Health (NJDOH). A more detailed budget review of 30 hospital cost centers was conducted by the NJDOH.

New Jersey implemented its DRG-based prospective payment system in 1980, phasing in hospitals over a three-year period. Hospitals entered the program in groups of 26, 36, and 36 in 1980, 1981, and 1982, respectively, and remained on the SHARE program until being phased onto DRGs. Unlike the previous rate-setting efforts, the DRG-based program regulated the rates to be paid by all payors, from individual patients to major third party insurers, such as Blue Cross and Medicare.

STRUCTURE AND OBJECTIVES OF THE DRG RATE-SETTING PROGRAM

Under the New Jersey DRG-based prospective payment program, hospitals are paid a fixed amount for each inpatient inlier admission. The amount is determined by the DRG into which the patient is classified. Each hospital has its own schedule of DRG payment rates. The rates are calculated to cover only direct patient care costs. To cover the total costs per admission, the DRG rates are marked up by a hospital-specific factor. The total amount paid to a hospital for a given DRG is a function of three variables: the hospital's historical cost for the DRG, the statewide average or standard cost for the DRG

across peer hospitals, and a hospital-specific add-on to cover approved overhead and other indirect costs. Separate statewide standards (average costs) are calculated for hospitals grouped into three categories based on teaching status—major teaching, minor teaching, and nonteaching.

The critical aspect of this approach is that hospitals are paid the same amount for all inlier patients in the same DRG regardless of each patient's actual treatment cost. A hospital will earn a surplus on a given DRG if the amount paid for each admission exceeds its average cost in that DRG. If its average cost for a DRG exceeds the fixed payment rate, the hospital will sustain a loss. The overall profitability of a hospital for all DRGs will depend on the distribution of admissions across different DRGs and the profitability of each DRG.

The New Jersey program is designed to achieve several objectives beyond improved hospital efficiency. For example, hospitals with large accounts receivable improved their financial stability under the DRG program by receiving "cash infusion" payments as part of their hospital-specific mark-up. Another important feature of the New Jersey DRG system is reimbursement for uncompensated care. Unlike previous rate-setting programs in New Jersey, the DRG program includes in each hospital's payment rate an additional amount to cover the costs of uncompensated care. In addition, the New Jersey system is designed to ensure that hospitals will be able to replace capital assets as they wear out. To do this, the hospital-specific mark-up factor includes a capital facilities allowance, which is more generous than allowances under previous systems.

A final objective reflected in the structure of the system is that payment rates be fair and equitable. Under previous systems, hospitals were able to charge different amounts to different payors for the same service. The DRG system attempts to prevent such cost shifting by setting DRG rates equal across all payors (except for small discounts given to Blue Cross, Medicare, and Medicaid patients). However, to the extent that hospital costs vary by payment source, setting uniform rates by payor may not guarantee fairness.

Another important feature in ensuring fairness is the outlier provision. Outliers are patients who are atypical or who differ significantly from the average LOS so much so that it is considered unfair to base payment solely on the DRG. The New Jersey program defines several categories of outliers based on LOS (short or long), death, discharge against medical advice, low volume (less than five admissions in a DRG category), or clinical heterogeneity (DRGs in which resource use varies widely across patients). Approximately one-quarter of all admissions are defined as outliers. Reimbursement for outliers is based on "controlled charges," which are designed to reflect reasonable costs.

INCENTIVES OF THE DRG RATE-SETTING PROGRAM

By paying a fixed amount per admission, the New Jersey DRG-based PPS creates an incentive for hospitals to reduce average cost per admission. Hospitals may choose from alternative strategies to achieve this goal.

- Hospitals can lower their costs of providing a certain amount of care by increasing their efficiency or paying less for inputs.
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The New Jersey experience with an all-payor PPS provides a good opportunity to evaluate hospital responses to the new incentive structure. In particular, our study explores the following questions.

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- Do patients admitted under an emergency or urgent status represent an identifiable group whose costs are systematically higher than patients admitted on an elective basis after controlling for DRG?

PREVIOUS LITERATURE

The effect of DRG-based prospective payment systems on hospital behavior and performance has been the subject of a number of studies. These studies focus either on the Medicare PPS program or on New Jersey.

A comprehensive analysis of the effects of the Medicare PPS program was conducted by Feder et al. (1987). This study had two basic

objectives. The first was to determine whether there are significant differences in the performance of hospitals paid through the PPS and those paid through provisions enacted by the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA). The reason for this comparison is the difference in the two systems' incentives for cost containment. Both TEFRA and PPS limited the rates of increase in Medicare payments to hospitals, but only under PPS do hospitals bear the full financial consequences of spending more or less than the established payment rate. By comparing hospitals under PPS with those under TEFRA, the effects of the opportunity to earn profit can be determined. The second objective was to examine differences in performance among hospitals facing different financial pressures under PPS. Financial pressure was measured by the proportion of a hospital's payment that was based on the national average rate as opposed to the hospital-specific average rate.

Feder et al. conclude that PPS did indeed encourage hospitals to contain costs, but its structure led Medicare to pay (and hospitals to earn) more than was necessary to achieve cost containment. Comparing hospitals paid under PPS and those paid under TEFRA revealed that allowing hospitals to keep any difference between preestablished Medicare payments and hospitals' actual costs slows the growth in hospital costs. Comparing hospitals facing different financial pressures under PPS showed that the opportunity to earn a profit leads hospitals to slow increases in Medicare costs, regardless of the level of revenue constraint. However, the more PPS constrained hospitals' revenues, the more they held their Medicare costs in check.

There have been several studies of the effects of the New Jersey DRG-based PPS program on hospital behavior. Rosko and Broyles (1987, 1986) conducted two studies: one that compared the two prospective payment programs (SHARE and DRGs) that were in effect during the 1980–1982 transition period, and a second that compared hospitals in New Jersey with hospitals in contiguous counties in eastern Pennsylvania during the period 1975–1982. Using a multivariate regression model and data from the American Hospital Association's (AHA's) *Annual Survey of Hospitals*, they found that compared with the per diem SHARE program, New Jersey hospitals on the DRG system reduced cost per admission (4.4 percent on average) and average length of stay (3.4 percent on average) and increased admissions. Cost per day was not significantly different between the two systems. The second study showed that increases in cost per admission and cost per day were lower (by 14 and 9.8 percent, respectively) in hospitals subject to all-payor DRGs in New Jersey than in hospitals reimbursed retrospectively in eastern Pennsylvania.

Admissions increased under the New Jersey DRG-based program (by approximately 11 percent). Changes in average length of stay were not significantly different.

Also using data from the AHA's *Annual Survey of Hospitals*, Hsiao and Dunn (1987) examined trends in hospital costs per capita in New Jersey for the period 1971–1984. This analysis revealed no significant change in per capita cost inflation following the introduction of the DRG-based PPS in 1980, compared to the SHARE system. In another study, Hsiao et al. (1986) examined responses of New Jersey hospitals in different financial positions (surplus, breakeven, and deficit) before entering the DRG program. They compared the rate of increase in expense per admission for the three groups of hospitals before and after the introduction of DRGs. Hospitals with a financial deficit reduced expense per admission to a greater degree than hospitals with a financial surplus.

As with the previous studies, we examine hospital responses to the DRG-based system using hospitals as the unit of analysis. However, we investigate a broader range of hospital responses than the previous studies. In addition to average cost per admission, average length of stay, average cost per day, total admissions, and total costs, our hospital performance measures include changes in the mix of hospital inputs, labor expenses, and gross and net revenue.

We also examine whether hospitals expecting to be in different financial positions respond differently to the effects of the all-payor, DRG-based program. Whereas Hsiao et al. classified hospitals according to their financial position three years before the introduction of DRGs, we classify hospitals according to their expected financial position once they are on DRGs. We expect that hospital responses to the DRG system are more closely linked to their expected financial position once the system is implemented than to their financial position three years before implementation. One reason for this is that the DRG-based system introduced provisions designed specifically to help hospitals in weak financial positions. So, hospitals with a deficit three years before the introduction of DRGs may not necessarily be expecting to incur losses under the DRG system.

The published studies by Hsiao and Dunn and Hsiao et al. examine variations in trends of the hospital performance measures. They do not use multivariate models to control for factors that could influence the hospital dependent variables (although they note that such studies are forthcoming). In Sec. III, we include multivariate analyses as well as descriptions of the trends in the dependent variables.

Whereas the previous studies focus on hospitals as the unit of analysis in measuring hospital responses to the DRG-based system, we

include patient-level analyses in our study. Our analyses in Secs. IV and V investigate the distributional effects and the equity of the all-payor DRG-based program. Section IV examines differences in resource use by payment source and whether hospitals alter admission patterns for selected payor categories. Section V examines differences in resource use by admission status and whether an adjustment to the DRG rate based on admission status is desirable.

III. HOSPITAL RESPONSES TO THE ECONOMIC INCENTIVES OF AN ALL-PAYOR, DRG-BASED PAYMENT SYSTEM

CONCEPTUAL FRAMEWORK AND RESEARCH HYPOTHESES

The appeal of prospective reimbursement as a means of controlling health care costs derives from the behavioral assumptions upon which it is based. Prospective reimbursement allows policymakers to limit cost increases without having to make specific resource allocation decisions. Instead, health care providers are given the flexibility to decide how and where resources should be employed. At the same time, incentives are applied to encourage the efficient delivery of services. Prospective reimbursement relies on economic incentives similar to those present in other industries that appear to operate efficiently. If these economic incentives can be used to improve the performance of the health care system, policymakers can spend less of their limited resources on detailed regulatory decisions.

A fundamental assumption implicit in prospective reimbursement programs is that hospital behavior is determined to a significant extent by the desire to increase profits and the constraints faced in attempting to do so. By paying a fixed rate set in advance and allowing hospitals to retain revenue that exceeds production costs (a distinct change from cost-based reimbursement), while at the same time placing hospitals at risk should costs exceed revenue, DRG-based prospective reimbursement systems provide hospitals with an economic incentive to lower costs or to, at least, restrain the increase in costs. Hospitals that are able to improve efficiency and lower costs will benefit by increasing their net income. The basic behavioral assumption underlying this approach is that hospitals will respond to these financial incentives in much the same way as a profit-maximizing firm. The questions of whether and how hospitals respond to the economic incentives provided by the New Jersey DRG-based rate-setting program form the basis of our empirical analysis.

Incentives of DRG-Based Payments in New Jersey

We use the model of a profit-maximizing firm to identify the potential effects of the New Jersey DRG-based prospective payment program. A hospital faced with a set of fixed DRG prices, can protect or increase net revenue by altering the level or mix of services provided, by altering the level or mix of inputs, or by reducing the price it pays for inputs. If the program is successful in inducing improvements in hospital efficiency, we expect the following kinds of behavioral responses to the DRG program:

- Hospitals will reduce slack by reducing the quantity of inputs used to meet a given level of output.
- Hospitals will improve scheduling and organization of work to increase the level of output with existing inputs.
- Hospitals will change the mix of inputs by substituting less expensive inputs.
- Hospitals will attempt to lower the price they pay for inputs.

Two questions are addressed in the first component of the study. The first is whether hospitals respond to the economic incentives posed by DRG-based prospective reimbursement by lowering average cost per admission and whether overall cost savings are achieved. The question arises as to whether all hospitals respond similarly to the economic incentives of a fixed price payment system. High-cost hospitals faced with losses may indeed reduce costs, whereas low-cost hospitals faced with a surplus may decide to spend their profits and thereby raise their costs, or simply to maintain their costs at historic levels. The second question asks whether hospitals expecting a surplus under the DRG system respond differently from hospitals expecting a loss.

We characterize hospitals as expected winners, losers, or neutrals in each year according to whether their expected profit margins under the DRG system are positive, negative, or close to zero. A fourth group of hospitals consists of facilities not yet on DRGs in the given year (remaining instead on the SHARE system). To classify the hospitals on the DRG system, the expected profits are estimated by assuming that the hospitals retain the cost structure they have at the beginning of the year. If they modify their cost structure during the course of the year, their actual surplus or loss position may not match the expected profit or loss position. Expected, rather than actual, profits are used to classify hospitals because the intent of this study is to measure how hospitals reacted to the incentives facing them. Measuring actual profit once a hospital is on DRGs captures the effect of the hospital's reactions and provides a distorted picture of the incentives the hospital initially faced.

DATA SOURCES AND METHODOLOGICAL APPROACH

We describe the data sources, construction of the analysis file, and specification of the empirical model. Our analysis of hospital responses is divided into two components: The first is an analysis of the responses aggregated over all hospitals included in the study; the second examines the responses of hospitals grouped by whether they expect to win, lose, or break even under the DRG-based payment system.

Data Sources

The individual hospital serves as the unit of analysis. Our sample includes short-term, general, acute care hospitals in New Jersey that were operating during the period 1975–1983. The sample for the aggregate analysis includes 88 hospitals. The sample for the disaggregate analysis includes fewer hospitals, 77, because 11 hospitals lack the data needed to determine their expected profitability.

To measure the effect of the introduction of the all-payor DRG rate-setting system on hospital behavior, we include data from five years (1975–1979) preceding the introduction of the system and for four years (1980–1983) following its introduction. The inclusion of multiple years of data before 1980 allows us to control for trends in the dependent variables before introduction of the all-payor system (when hospitals were on the SHARE system).

Data were obtained from two major sources: *The Annual Survey of Hospitals* by the American Hospital Association (AHA) and the *Schedule of DRG Rates* from the New Jersey Department of Health (NJDOH). The AHA data cover nine years from 1975 through 1983. All of the dependent variables used to measure hospital responses were obtained from the AHA survey data. The AHA data were supplemented with information from the NJDOH on the date each hospital entered the DRG program, on teaching status, and on hospital location and with data from AHA reports on national trends in hospital performance.

The *Schedule of DRG Rates* contains the actual payment rates, the average accounting cost, and the number of discharges for each DRG in each hospital in 1979.[1] An average accounting profit for each DRG was calculated for each hospital by subtracting the estimated average accounting cost from the average revenue (i.e., the payment rate) the hospital received for the DRG. The total accounting profit for an

[1]Because the DRG payment rate incorporates a hospital-specific component, each hospital has a different set of payment rates.

individual DRG in a single hospital was calculated by multiplying the number of admissions in the DRG by the average profit. The total accounting profit for a hospital was then calculated by summing the total profit for each DRG.

Measurement of Profits and Costs

Many of the analyses in the report use measures of profits and average costs to evaluate the effects of DRGs on hospital behavior. It is therefore important to briefly review how these variables are constructed and to recognize their limitations. The following is a brief description of key variables.

Accounting profits are calculated as the difference between net revenue and accounting costs at either the DRG or hospital level.

Revenue is defined to equal the amount paid to the hospital under the rate-setting program for each DRG. Total revenue for all DRGs depends on the distribution of discharges across DRGs and the hospital's DRG payment schedule. Revenue per patient is constant within each DRG for each hospital regardless of the level of output.

Accounting cost per case includes direct and indirect patient care costs. The *average accounting cost* per case is defined to be constant within each DRG within each hospital and does not vary with the level of output. Because of data limitations, we are only able to measure average accounting costs. We are not able to measure *marginal cost,* which is defined as the increase in cost associated with producing one more unit of output.

To determine the impact on profitability of changes in the volume within a DRG, we must be able to measure the marginal cost of treating an additional patient within a DRG. However, we are using average accounting costs. Hence, a hospital or DRG showing an accounting profit (or loss) may not have actually incurred an economic profit (or loss). For a discussion of the differences between accounting profit and economic profit, see Cretin et al. (1986).

Construction of the Analysis File

The analysis file was constructed by pooling the data for all years and all hospitals, thus creating a time series of cross-sectional data. For the aggregate analysis, the resulting file contained 792 observations drawn from the 88 hospitals over the nine-year study period. Even though the AHA survey contained data for 88 short-term, general, acute care hospitals in New Jersey, complete payment report data were available only for 77 hospitals. Consequently, the sample for the disaggregate analysis, comparing the performance of hospitals expecting to have different financial positions, was limited to 77 hospitals.

Adjustments to the Data

Before using the AHA Annual Survey data, we performed several adjustments. The AHA Annual Survey requests that hospitals provide data covering a 12-month period beginning October 1 of each year. Actual responses to the survey do not conform to this request for a consistent and common reporting period. For this reason, we adjusted the AHA data to a common reporting period of October through September for each year. In addition, all monetary variables were deflated to 1975 dollars using the AHA national hospital market basket price index.

Empirical Approach—Aggregate Hospital Responses

Estimation Technique. To estimate the effects of the introduction of the all-payor, DRG system on hospital behavior, we use multivariate regression techniques, employing a fixed-effects, time series, cross-section model. The general form of the model is as follows:

$$Y = b_0 + b_{1-87}\text{HD} + b_{88}\text{USCON} + b_{89}\text{DRGPRGRM} + \epsilon$$

where Y = dependent variable,
HD = hospital dummy variable,
USCON = national control variable,
DRGPRGRM = DRG program measure, and
ϵ = error term.

Four categories of dependent variables, described in the next subsection, measure the possible effects of the DRG rate-setting system on hospital behavior. HD is a set of binary variables for each hospital except one. Inclusion of these variables allows each hospital to act as its own control for effects that are not captured by other variables in the equation. USCON measures the dependent variable at the national

level in each year. DRGPRGRM represents the introduction of the all-payor DRG program. The estimated coefficient for this variable represents the effect of the rate-setting program on the dependent variable. It provides a quantitative measure of the average effect of the all-payor DRG program across all hospitals for all of the years they were covered by the program.

The above specification is used to measure the average effect of the all-payor DRG program on all hospitals measured from the time they go on the program (i.e., the average effect). We tested three other models as well, but found that the results were not substantially different, and so are only reporting the results for this single model.[2]

Functional Form. The functional form of the dependent variables and the continuous explanatory variables is logarithmic. The functional form of the estimated equations is log-linear, which implies that the relationship between the dependent variable (Y) and the explanatory variables ($X_1, \ldots, X_n$) is as follows:

$$Y = exp(b_0 + b_1X_1 + \cdots + b_nX_n)\ exp(\epsilon)$$

Taking the natural logarithm of both sides of this equation, we get the log-linear form:

$$ln(y) = b_0 + b_1X_1 + \cdots + b_nX_n + \epsilon$$

This has the convenience of allowing one to interpret the estimated coefficients of the DRG program measures as approximate elasticities. The coefficient of a dichotomous variable in a log-linear regression can be transformed into an exact measure of the percentage difference between the identified group and the reference group. The transformation is $exp(b) - 1$, where b is the estimated coefficient. For example, an estimated coefficient for DRGPRGRM of 0.050 in the total admissions equation would indicate that hospitals on the DRG rate-setting system increased admissions by 5.1 percent (exp (0.05) − 1) relative to hospitals not on the DRG rate-setting system. All of the percentage differences reported in the text have been transformed, although the actual untransformed coefficients are reported in the tables.

Construction of Dependent Variables. The dependent variables measure the effects of the DRG program on four categories of hospital behavior: utilization, inputs, expenses, and revenues. Construction of the variables in each of these categories is summarized in Table 3.1.

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[2]The three other models were: (1) the cohort effect—the effects of the DRG program on hospitals based on the year they entered the program (from 1980–1982); (2) the learning curve effect—the effects of DRGs as a function of the number of months a hospital has been on the program; (3) the anticipatory effect—the effects of DRGs on hospitals before they enter the program.

Variables that reflect hospital utilization include admissions, patient days, length of stay, surgical operations, and occupancy rate. Hospital inputs include labor expense per admission and per day as well as measures of the actual number of personnel and of physical inputs (e.g., beds). Expenses include measures of both total expenses and expense per unit of volume (either per admission or per patient day). The revenue variables include measures of both gross and net patient revenues. Separate variables are included for total (inpatient plus outpatient) revenue and outpatient revenue.

National Control Variables. A national control variable is associated with each dependent variable and with few exceptions is constructed in the same manner. The national control variables measure trends in the dependent variable at the national level for the years 1975–1983. For example, if the dependent variable is the hospital's total annual expense for each year between 1975 and 1983, the national control variable is the total hospital expense for the entire United States in each of the years 1975–1983, deflated to 1975 dollars. The only equations in which the control variables are not defined in exactly the same way as the dependent variables are the revenue equations, since revenue data are not available in published form from the AHA. Instead, these equations use total expenses as the national control variable.

Construction of the DRG Program Measure. The DRG program measure is a dummy variable that indicates whether the hospital is on or off the all-payor DRG program. Hospitals were phased onto the DRG program over a three-year period from 1980 through 1982. The dummy variable is coded 0 in all years the hospital is not on the DRG program and 1 in all years it is on the DRG program. A hospital is considered to be on DRGs in a particular year if it has been on the program for three months or more in that year.

Empirical Approach—Hospital Responses by Expected Financial Position

Estimation Technique. For this part of the study, we again used a fixed effects, time series, cross-section model. The general form of the model is slightly different from that used in the aggregate analysis. It is as follows:

$$Y = b_0 + b_{1-76}\text{HD} + b_{77-84}\text{YEAR} + b_{85}\text{DRGSTAT}$$

$$+ b_{86-88}\text{EXPROFIT} + \epsilon$$

Table 3.1

CONSTRUCTION OF DEPENDENT VARIABLES

Dependent Variable	Definition
	Hospital Utilization
Total inpatient admissions	Total inpatient admissions excluding newborns
Total adjusted inpatient admissions	Total inpatient admissions plus estimated equivalent admissions for outpatient activity using AHA method
Total inpatient days	Total inpatient days excluding newborns
Total adjusted inpatient days	Total inpatient days plus estimated equivalent days for outpatient activity using the AHA method
Average length of stay	Total inpatient days divided by total inpatient admissions
Total inpatient surgical operations	Total reported surgical procedures performed on an inpatient basis
Total surgical operations per admission	Total inpatient surgical operations divided by total inpatient admissions
Occupancy rate	Total inpatient days divided by (number of beds × 365 days)
	Hospital Inputs
Total labor expenses per adjusted admission	Total payroll and benefits divided by total adjusted admissions
Total labor expenses per adjusted patient day	Total payroll and benefits divided by total adjusted patient days
Total beds	Total beds set up and staffed
FTE RNs per bed	Full-time equivalent Registered Nurses divided by total beds
FTE LPNs per bed	Full-time equivalent Licensed Practical Nurses divided by total beds
	Hospital Expenses
Total expenses	Total operating expenses including capital expenses
Total expenses per admission	Total operating expenses including capital expenses divided by total inpatient admissions
Total expenses per adjusted admission	Total operating expenses including capital expenses divided by total adjusted inpatient admissions
Total expenses per inpatient day	Total operating expenses including capital expenses divided by total inpatient days
Total expenses per adjusted inpatient day	Total operating expenses including capital expenses divided by total adjusted inpatient days
	Hospital Revenues
Total gross revenues	Total charges to inpatients and outpatients
Total outpatient revenues	Total charges to outpatients
Percent gross revenue from outpatients	Total charges to outpatients divided by total charges to to inpatients and outpatients
Total net revenue	Total revenue collected from inpatients and outpatients and from nonpatient care sources
Total net revenue per adjusted admission	Total net revenue divided by total inpatient admissions

The dependent variables measure hospital behavior along the same dimensions used in the aggregate analysis. The individual variables that measure each of the four types of responses include many of the same variables used in the aggregate analysis and are identified in the next subsection. Hospital dummy variables (HD) control for hospital-specific differences that persist over time. The YEAR variables consist of a dummy for each year (1976–1983, omitting 1975, which serves as the reference category) to control for changes in the dependent variables over time not associated with the DRG rate-setting program that may have affected all hospitals in the state. DRGSTAT indicates the proportion of the year in which a hospital was on the DRG system. The estimated coefficient for DRGSTAT measures any shift in the dependent variable resulting from the introduction of the all-payor system. EXPROFIT variables represent the expected financial status of hospitals under DRGs. The measure consists of three binary variables: LOSER represents hospitals that would incur a loss under DRGs; WINNER represents hospitals that would earn a surplus under DRGs; and SHARE represents hospitals that were not yet on DRGs and so remained on the SHARE system. The omitted category, which forms the comparison group, consists of hospitals that would expect to break even on DRGs. The procedures for classifying hospitals into these groups are described in the next subsection.

Identification of Hospitals with Expected Losses and Surpluses. To examine whether hospitals responded differently to the DRG program based on their expected profitability, we divided hospitals who were on the all-payor DRG system into three groups: hospitals with significant expected losses, hospitals with significant expected surpluses, and hospitals expecting to break even. These groups were formed using the following procedures.

Calculate Expected Profit for Each Hospital. Using data from 1979, the year preceding introduction of DRGs, we first calculated for each hospital the average expected profit per admission for each DRG.[3] The 1979 payment rate was calculated as if the hospital were on DRGs in 1979. To calculate a hospital's average expected profit by DRG we subtracted the hospital's average cost for the DRG from its payment rate.

Next, we calculated the total expected profit for each hospital by multiplying the average expected profit per admission for each DRG by the number of admissions in each DRG during 1979. The resulting expected profit estimate pertains only to direct patient care costs for

[3]Our measure of profitability under DRGs assumes that any profits associated with payment for overhead and indirect costs is proportionate to our measure of profits based solely on DRG payments.

inlier patients. Outlier patients are removed from the data set before determining the total profit amount, since by regulatory definition average and total profits for outliers are approximately zero.

Calculate Expected Profit Margins for Each Hospital under DRGs. We then calculated an expected profit margin for each hospital as follows:

$$\frac{\text{total expected profits from inliers}}{\text{total direct patient care costs for inliers and outliers}}$$

The resulting expected margin provides an estimate of the percentage difference between total direct patient care costs and reimbursement to cover these costs. To capture the fact that hospitals were phased onto DRGs at different times, the expected profit margin for fiscal years 1980–1983 was multiplied by the percentage of time during a year that a hospital was on the DRG program.

Classify Hospitals into Winners and Losers. The final step involved grouping hospitals according to relative profitability. The three categories of expected profitability were defined using the following cutoff points:

Expected winner	Profit margin = 1.5 percent or above
Expected loser	Profit margin = −1.5 percent or less
Expected neutral	Profit margin between −1.5 and 1.5 percent

EMPIRICAL RESULTS—AGGREGATE HOSPITAL RESPONSES

We first describe the characteristics of hospitals covered by the DRG program. Then we briefly discuss the trends in the dependent variables for the period before and after the introduction of DRGs. Finally, we discuss the regression analyses estimating the average effects of the DRG program on hospital behavior.

Characteristics of New Jersey Hospitals Covered by the DRG Program

Table 3.2 presents the characteristics of New Jersey hospitals, which are grouped according to the fiscal year in which they adopted the all-payor DRG rate-setting program. The figures are based on 1980 data for all hospitals regardless of the year they entered the rate-setting program.

Hospitals were phased onto the program during four fiscal years beginning in 1980. They entered the program in groups of 17, 38, 11,

Table 3.2

CHARACTERISTICS OF NEW JERSEY HOSPITALS BY YEAR OF DRG IMPLEMENTATION

Characteristic	FY 1980	FY 1981	FY 1982	FY 1983
No. of hospitals	17	38	11	22
Percent of hospitals	19.3	43.2	12.5	25.0
Teaching status				
Nonteaching	9	28	6	17
Minor teaching	5	5	4	3
Major teaching	3	5	1	2
Location				
Inner city	3	11	3	4
Urban	5	9	6	5
Suburban	5	13	2	9
Rural	4	5	0	4
Average no. of beds	326	302	305	297
Average no. of admissions	12,603	11,027	10,352	9,958
Average length of stay, days	7.8	8.4	8.7	9.0
Average patient days	97,838	91,944	89,799	89,715
Average occupancy rate, %	0.85	0.84	0.79	0.82
Average total expenses, $	16,358,604	13,943,782	13,494,509	14,956,661
Cost per admission, $	1,250	1,255	1,283	1,503
Cost per adjusted admission, $	1,059	1,103	1,113	1,361
Cost per day, $	161	149	150	165
Cost per adjusted day, $	137	131	130	145

NOTE: All of the data are from 1980.

and 22, in fiscal years 1980, 1981, 1982, and 1983, respectively.[4] Slightly fewer than one-fifth of the hospitals entered the program in the first fiscal year. By the end of the second fiscal year, more than half of the hospitals were on the program. Entry of hospitals onto the program was a nonrandom process. Hospitals implementing the program in the early years consisted largely of volunteers.

The average number of beds, admissions, and patient days in hospitals entering in the first year is slightly larger than in hospitals entering in later years. Average length of stay is lower in hospitals entering in the first year. The hospitals entering the program in the last year appear to have the highest average unit costs, measured on the basis of both cost per adjusted admission and cost per adjusted inpatient day.

[4]Hospitals that entered in FY 1983 were on the system by December 1982.

Table 3.3

TRENDS IN HOSPITAL UTILIZATION IN NEW JERSEY, 1975–1983

Dependent Variable	Year									Average Annual Change	
	1975	1976	1977	1978	1979	1980	1981	1982	1983	75–79	80–83
Admissions	10,494	10,583	10,671	10,595	10,753	10,983	11,235	11,378	11,543	64.75	186.66
% change		0.85	0.83	−0.71	1.49	2.14	2.29	1.27	1.45	0.61	1.67
Adjusted admissions	11,937	12,065	12,155	12,088	12,497	12,657	13,182	13,434	13,829	140.00	390.66
% change		1.07	0.75	−0.55	3.38	1.28	4.15	1.91	2.94	1.16	3.00
Inpatient days	88,936	89,346	89,746	89,829	90,909	92,252	93,345	92,239	91,674	493.25	−192.67
% change		0.46	0.45	0.09	1.20	1.48	1.18	−1.18	−0.61	0.55	−0.20
Adjusted inpatient days	101,093	101,847	102,229	102,469	106,292	106,916	110,092	109,111	110,258	1299.75	1114.00
% change		0.75	0.38	0.23	3.73	0.59	2.97	−0.89	1.05	1.27	1.04
ALOS	8.51	8.48	8.49	8.57	8.56	8.47	8.34	8.14	7.96	0.01	−0.17
% change		−0.35	0.12	0.94	−0.12	−1.05	−1.53	−2.40	−2.21	0.15	−2.05
Occupancy rate	0.81	0.81	0.82	0.82	0.82	0.83	0.83	0.82	0.81	0.00	−0.01
% change		0	1.23	0	0	1.22	0	−1.20	−1.22	0.31	−0.81
Outpatient visits	63,300	66,005	62,839	64,697	66,376	59,556	73,336	98,299	64,169	769.00	1537.67
% change		4.27	−4.80	2.96	2.60	−10.27	23.14	34.04	−34.72	1.26	7.49
Total surgeries	5,568	5,521	5,584	5,515	5,007	4,992	5,061	5,002	4,959	−140.25	−11.00
% change		−0.84	1.14	−1.24	−9.21	−0.30	1.38	−1.17	−0.86	−2.54	−0.21
Surgeries per admission	0.53	0.51	0.53	0.52	0.47	0.46	0.45	0.45	0.43	−0.02	−0.01
% change		−3.77	3.92	−1.89	−9.62	−2.13	−2.17	0.00	−4.44	−2.84	−2.21

Hospital Utilization Trends

Trends in nine measures of hospital utilization are presented in Table 3.3. Although no definitive statements about attribution can be made using simple trend data such as those presented here, we include them to illustrate the levels of the dependent variables in New Jersey during the period of analysis.

Total admissions and total adjusted admissions increased at an average annual rate of 0.6 and 1.2 percent, respectively, during 1975–1979 and increased at a greater rate (1.7 and 3.0 percent) following the introduction of the DRG-based payment system. During the period preceding introduction of DRGs, average length of stay (ALOS) increased at an average annual rate of 0.2 percent, but after 1980, it decreased at an average annual rate of 2.1 percent. Outpatient visits show substantial volatility from year to year. For example, they increased by 65.1 percent between 1980 and 1982 but dropped by 34.7 percent the following year. The large jumps in outpatient data suggest caution in interpreting findings associated with this variable. It is interesting to note, however, that the trends in New Jersey outpatient data are paralleled by national data on hospital outpatient visits.

Trends in Uses of Hospital Inputs

Table 3.4 presents data on trends in hospital input use. Real labor expense per adjusted patient day increased at an average annual rate of 1.6 percent in the period preceding DRGs and at a faster rate (3.5 percent) following 1980. Labor expense per adjusted admission grew at a similar rate before and after 1980, suggesting that although patients were treated in fewer days per stay, the same quantity of labor inputs was used. It appears that hospitals slowed the rate at which they added new FTE RNs: RNs per bed were added at an average annual rate of 3.9 percent before 1980 and at a slower rate of 1.0 percent afterward.

Trends in Hospital Expenses

Table 3.5 presents data on trends in hospital expenses. The average annual growth rate of average cost per admission and per adjusted admission was smaller for the years after 1980 than for the years preceding 1980. However, the growth rate of cost per patient day appears to have increased after 1980 (this can partially be explained by the decrease in ALOS—as LOS decreases, there are fewer days over which to spread the costs, resulting in somewhat higher unit costs per

Table 3.4

TRENDS IN USES OF HOSPITAL INPUTS IN NEW JERSEY, 1975–1983

Dependent Variable	Year									Average Annual Change	
	1975	1976	1977	1978	1979	1980	1981	1982	1983	75–79	80–83
Beds	299	300	301	302	304	306	307	307	309	1.25	0.67
% change		0.33	0.33	0.33	0.66	0.66	0.33	0	0.65	0.42	0.33
FTE RNs per bed	0.55	0.58	0.59	0.60	0.64	0.68	0.66	0.69	0.70	0.02	0.01
% change		5.45	1.72	1.69	6.67	6.25	−2.94	4.55	1.45	3.89	1.02
FTE LPNs per bed	0.22	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.23	0	0
% change		0	0	0	0	4.55	0	0	0.00	0	0
Labor expense per adjusted admission	658.10	679.19	692.93	704.11	707.18	681.05	672.18	685.72	707.37	12.27	11.73
% change		3.20	2.02	1.61	0.44	3.69	−1.30	2.01	3.16	1.82	1.29
Labor expense per adjusted patient day	76.84	79.80	81.13	81.78	81.79	79.72	79.90	84.44	88.40	1.24	2.83
% change		3.85	1.67	0.80	0.01	−2.53	0.23	5.68	4.69	1.58	3.53

day). Total hospital expenses increased at a faster rate after 1980, increasing at an average rate of 4.2 percent after 1980 compared with 2.7 percent before 1980.

Trends in Hospital Revenues

Table 3.6 presents data on trends in hospital revenues. The rate of growth in gross revenue appears to have fallen significantly after 1980. Before 1980, gross revenues increased at an average annual rate of 6.0 percent, but after 1980, the rate of growth slowed to less than 1 percent per year on average. The growth rate of net revenue per adjusted admission decreased from an average annual rate of 2.0 percent before 1980 to a rate of 0.8 percent after 1980. Total net revenue, however, grew at nearly the same average annual rate (3.2 to 3.8 percent) during the two time periods.

Regression Results

This subsection presents the empirical results of our multivariate analyses of the four sets of measures of hospital behavior. To conserve space, only the the estimated coefficients for the DRG program are presented.

Utilization Regressions. The results for the dependent variables measuring utilization effects are presented in Table 3.7. The all-payor DRG-based program increased both admissions and adjusted admissions,[5] 3.6 percent and 5.3 percent, respectively, above what admissions would have been in the absence of the payment system.[6] Although hospitals increased admissions, they decreased average length of stay by 3.1 percent from 1980 to 1983, so that total (unadjusted and adjusted) inpatient days and occupancy rates remained unchanged. Outpatient visits fell by 7.9 percent. Total surgical inpatient operations and surgical operations per admission appear to have not been affected by the DRG program.

Input Use Regressions. The estimated effects are presented in Table 3.8. New Jersey's payment system led to reductions in labor costs per adjusted admission (4.7 percent) and per adjusted inpatient day (1.4 percent). The number of LPNs per bed fell by 4.7 percent, whereas the number of RNs per bed remained unchanged. Although

[5]Adjusted admissions incorporate outpatient utilization as well as inpatient admissions.

[6]Percentage differences between hospitals on and off the DRG program are determined by transforming the coefficients presented in the tables by $exp(b) - 1$, where b is the regression coefficient.

Table 3.5

TRENDS IN HOSPITAL EXPENSES IN NEW JERSEY, 1975–1983

Dependent Variable	Year									Average Annual Change	
	1975	1976	1977	1978	1979	1980	1981	1982	1983	75–79	80–83
Total expense per admission	1228	1283	1315	1333	1344	1316	1311	1354	1391	28.99	26.87
% change		4.47	2.50	1.42	0.77	−2.05	−0.41	3.27	2.79	2.29	1.88
Total expense per adjusted admission	1079	1126	1154	1171	1183	1152	1140	1160	1190	26.09	16.89
% change		4.37	2.50	1.46	1.04	−2.67	−1.04	1.80	2.59	2.34	1.12
Total expense per inpatient day	144	151	155	156	157	155	156	166	174	3.21	5.76
% change		4.97	2.41	0.50	0.80	−0.97	0.62	6.23	4.55	2.17	3.80
Total expense per adjusted patient day	126	133	136	137	137	135	136	143	149	2.72	4.59
% change		4.96	2.41	0.56	0.47*	−1.54	0.38	5.49	4.42	2.10	3.43
Total expense (in thousands)	13,107	13,721	14,210	14,206	14,547	14,579	15,129	15,974	16,485	360	452
% change		4.68	3.56	−0.03	2.40	0.22	3.77	5.59	3.20	2.66	4.19

NOTE: The percentage change was calculated using more significant digits than appear in the table. Therefore, the percentage change from the previous year is 0.47 and not 0.

Table 3.6

TRENDS IN HOSPITAL REVENUES IN NEW JERSEY, 1975–1983

Dependent Variable	Year									Average Annual Change	
	1975	1976	1977	1978	1979	1980	1981	1982	1983	75–79	80–83
Gross revenue (in thousands)	15,697	16,820	18,155	18,586	19,834	19,304	19,304	19,044	19,460	1,034	52
% change		7.15	7.94	2.37	6.71	−2.67	0	−1.35	2.18	6.04	0.28
Net revenue (in thousands)	13,286	13,670	14,124	14,481	15,046	14,821	15,370	15,758	16,567	440	399
% change		2.89	3.32	2.53	3.90	−1.50	3.70	2.52	5.13	3.16	3.79
Net revenue per adjusted admission	1,113	1,133	1,162	1,198	1,204	1,171	1,166	1,173	1,198	23	11
% change		1.80	2.56	3.10	0.50	−2.74	−0.43	0.60	2.13	1.99	0.77
Total outpatient revenue	188,364	201,840	217,860	223,032	238,008	250,952	248,352	266,616	272,440	12,411	7,163
% change		7.15	7.94	2.37	6.71	5.44	−1.04	7.35	2.18	6.04	2.83
Percent revenue from outpatients	12.0	12.0	12.0	12.0	12.0	13.0	13.0	14.0	14.0	0	0.3
% change		0	0	0	0	8.33	0	7.69	0	0	2.56

Table 3.7

ESTIMATED EFFECTS OF DRG PROGRAM ON HOSPITAL UTILIZATION

Dependent Variable	Regression Coefficient
Total admissions	0.035* (0.008)
Total adjusted admissions	0.052* (0.008)
Average length of stay	−0.032* (0.005)
Total inpatient days	−0.005 (0.008)
Total adjusted inpatient days	0.009 (0.008)
Occupancy rate	−0.002 (0.005)
Total outpatient visits	−0.082** (0.036)
Total inpatient surgeries	0.008 (0.021)
Inpatient surgeries per admission	−0.008 (0.022)

NOTE: Figures in parentheses are standard errors.
*Significant at p = 0.01.
**Significant at p = 0.05.

Table 3.8

ESTIMATED EFFECTS OF DRG PROGRAM ON THE USE OF HOSPITAL INPUTS

Dependent Variable	Regression Coefficient
Labor expense per adjusted admission	−0.048* (0.009)
Labor expense per adjusted day	−0.014** (0.008)
Number of beds	−0.002 (0.008)
FTE RNs per bed	−0.015 (0.017)
FTE LPNs per bed	−0.048** (0.026)

NOTE: Figures in parentheses are standard errors.
*Significant at p = 0.01.
**Significant at p = 0.05.

labor expenses were reduced, the DRG program did not induce hospitals to reduce their capacity, as it had no effect on the average number of beds per hospital.

Hospital Expense Regressions. The estimated effects on hospital expenses are presented in Table 3.9. Hospitals achieved reductions in unit costs. Total hospital costs, however, appear to have not been affected by the payment system. Expense per admission was reduced by 4.7 percent and expense per adjusted admission fell by 6.2 percent in hospitals subject to DRGs. Total hospital expense per patient day and per adjusted patient day fell by 1.3 percent and 2.9 percent, respectively. Although total hospital expenses appear to have been reduced slightly, the effect is not statistically significant.

Hospital Revenue Regressions. The estimated effects of the DRG program on hospital revenues are presented in Table 3.10. New Jersey's hospital payment program reduced total gross revenue (16.8 percent), gross outpatient revenue (10.1 percent), and net revenue per adjusted admission (3.4 percent). However, total net revenue received by hospitals under the new payment system was not significantly different from that received by hospitals not subject to the new system. The percent of gross revenue derived from outpatients decreased by 7.4 percent.

Table 3.9

ESTIMATED EFFECTS OF DRG PROGRAM ON HOSPITAL EXPENSES

Dependent Variable	Regression Coefficient
Total expense per admission	−0.048* (0.009)
Total expense per adjusted admission	−0.064* (0.010)
Total expense per day	−0.013 (0.008)
Total expense per adjusted day	−0.029* (0.008)
Total expenses	−0.014 (0.010)

NOTE: Figures in parentheses are standard errors.

*Significant at p = 0.01.

**Significant at p = 0.05.

Table 3.10

ESTIMATED EFFECTS OF DRG PROGRAM ON HOSPITAL REVENUES

Dependent Variable	Regression Coefficient
Total gross revenue	−0.184*
	(0.015)
Total outpatient revenue	−0.106*
	(0.010)
Net revenue per adjusted admission	−0.035*
	(0.013)
Percent revenue from outpatients	−0.077*
	(0.019)
Total net revenue	0.012
	(0.012)

NOTE: Figures in parentheses are standard errors.

*Significant at p = 0.01.

**Significant at p = 0.05.

EMPIRICAL RESULTS—HOSPITAL RESPONSES BY EXPECTED FINANCIAL POSITION

In this subsection, we present our empirical findings regarding differential responses to the all-payor DRG program by hospitals expecting a loss compared with those expecting a surplus. The aggregate analyses presented in the previous subsection may indeed represent the responses of a typical hospital. On the other hand, an aggregate analysis may mask systematic differences in responses by different groups of hospitals. The purpose of this analysis is to determine whether both groups of hospitals respond similarly or whether hospital responses can be differentiated by the expected financial position of the hospital. Before we discuss the results of the regression analyses that measure the differences in responses, we describe some of the characteristics of hospitals expecting a loss or surplus.

Characteristics of Hospitals with Expected Losses or Surpluses

In this study we compare the behavior of four groups of hospitals:

- Hospitals with large expected losses under DRGs.
- Hospitals with large expected surpluses under DRGs.
- Hospitals that expect to roughly break even under DRGs.
- Hospitals not yet on DRGs (and, therefore, still on the SHARE program).

The assignment of hospitals to one of these four groups was not fixed over the nine years of the study period. Hospitals were phased onto DRGs over three years, so hospitals moved out of the SHARE program and into one of the three categories under the DRG rate-setting program. The assignment of hospitals to one of the three categories under DRGs is based on patient discharge data in 1979. The expected profit margin in fiscal years 1980–1983 is calculated by multiplying the expected profit margin in 1979 by the percentage of time during a year that a hospital was on the DRG program. Hospitals that enter the DRG program early in a fiscal year remain in the financial category in which they are initially classified. However, because expected profits are weighted by the proportion of time a hospital is on DRGs in a given year, hospitals on DRGs for a small part of the fiscal year may have little or no expected losses or surpluses for the first year but may have large expected losses or gains the following year. Table 3.11 shows the distribution of hospitals in the four categories over the period of the study.

Table 3.11

NUMBER OF HOSPITALS BY STATUS, 1975–1983

Fiscal Year	SHARE Program	Expected Surplus	Expected Loss	Break Even
1975–1979	77	0	0	0
1980	62	1	1	13
1981	26	7	8	36
1982	13	15	9	40
1983	0	17	24	36

As can be seen from Table 3.11, the majority of hospitals on the DRG program from 1980–1982 expected to roughly break even, whereas the other hospitals on DRGs were fairly evenly divided between those expecting surpluses and those expecting losses (except in 1982 when a higher proportion expected surpluses). However, by 1983 fewer than half the hospitals expected to break even. In that year, the number of hospitals with expected losses increased substantially.

Table 3.12 shows the characteristics of the three groups of hospitals (classified according to their 1983 standing) in 1979 before DRGs were implemented. We can thus see how these groups differed before DRG implementation.

Hospitals expecting either surpluses or losses were more likely to be nonteaching and less likely to be major teaching than hospitals expecting to break even. Minor teaching hospitals accounted for relatively similar shares of each category of hospitals.

Hospitals expecting surpluses were more likely to be located in either urban or rural areas and to experience a greater number of admissons per hospital. Their average length of stay and average expense per adjusted admission was lower than in the other two hospital groups. Hospitals expecting losses were more likely to be located in suburban areas and had the highest average length of stay and expense per adjusted admission of all of the hospital groups.

Regression Results

This subsection presents the empirical results of our multivariate analyses of four sets of measures of hospital behavior. Tables are presented showing the results of the four sets of regressions. The estimated coefficients for the 76 hospital dummy variables and the seven year dummy variables are omitted from the tables. The dependent variables in the regressions are in logarithmic functional form.

The regression equations indicate changes in the responses of three groups of hospitals (those not yet on DRGs, those with large expected losses, and those with large expected surpluses) compared with the group of hospitals on DRGs that expect to break even. The estimated regression coefficients of the three dummy variables SHARE, LOSER, and WINNER provide quantifiable measures of the effects of the DRG rate-setting system on the behavior of the three hospital groups relative to the comparison group. A significant coefficient on one of the three variables (indicated by asterisks in the tables) indicates that the hospital group responded differently from the comparison group. A nonsignificant coefficient does not indicate that the hospital group did not change its behavior with respect to the dependent variable, but

Table 3.12

CHARACTERISTICS OF HOSPITALS EXPECTING TO WIN, LOSE, OR BREAK EVEN UNDER DRGS

Variable	Expected Winners	Expected Losers	Expected Neutrals
Number of hospitals	17	24	36
Teaching status			
% major teaching	18	13	28
% minor teaching	12	13	14
% nonteaching	71	75	58
Location			
% inner city	6	21	31
% urban	35	21	31
% suburban	24	46	31
% rural	35	13	8
Number of beds	321	297	322
Number of admissions	12,084	10,032	11,273
Average length of stay, days	8.1	9.0	8.5
Occupancy rate, %	84	82	81
Average expense per adjusted admission, $	991	1,263	1,193
Total expenses, $	13,959,587	14,911,763	15,702,199
Total revenue, $	14,236,036	14,643,708	15,823,936

NOTE: The value of the variables is based on 1979 data.

only that its change in behavior was matched by hospitals that expect to break even on the DRG program.

We will focus primarily on the estimated coefficients of the WINNER and LOSER variables. Any differences between the coefficients of these two groups of hospitals indicate that hospitals expecting a surplus under DRGs react differently to the program's incentives than do hospitals expecting a loss. For example, estimated regression coefficients of −0.05 on WINNER and −0.10 on LOSER in the expense per admission regression equation indicate that both sets of hospitals reduced their expenses relative to the comparison group, but that hos-

pitals expecting losses reduced their expense per admission by twice the rate of hospitals expecting surpluses.[7]

Utilization Regressions. Table 3.13 presents the results for this set of regressions. Hospitals expecting a loss under DRGs had significantly different responses than did hospitals expecting a surplus, in terms of the number of admissions and average length of stay. Hospitals expecting a loss increased total inpatient admissions and adjusted admissions by 7.5 percent and 8.4 percent, respectively, relative to hospitals expecting to break even, whereas hospitals expecting a surplus increased admissions and adjusted admissions by 4.4 percent and 3.3 percent. Hospitals expecting a loss decreased average length of stay by 5.2 percent, whereas those expecting a surplus achieved a smaller reduction of 2.6 percent. Changes in total inpatient days and occupancy rates were not significantly different for the two groups of hospitals, relative to the comparison group. The estimated coefficients on the SHARE program variable indicate that changes in utilization for

Table 3.13

RESPONSES BY EXPECTED LOSERS AND EXPECTED WINNERS: REGRESSION RESULTS FOR UTILIZATION

Dependent Variable	Parameter Estimates			Output Statistics		
	SHARE Hospitals	Expected Losers	Expected Winners	R^2	F	N
Total admissions	−0.010	0.072*	0.043*	0.982	386.3	688
	(0.013)	(0.016)	(0.016)			
Total adjusted admissions	−0.020	0.081*	0.032**	0.983	399.9	674
	(0.013)	(0.016)	(0.016)			
Total patient days	−0.017	0.020	0.016	0.985	460.2	688
	(0.013)	(0.015)	(0.015)			
Average length of stay	−0.007	−0.053*	−0.026**	0.857	41.3	688
	(0.010)	(0.011)	(0.011)			
Occupancy rate	−0.016	−0.005	−0.016	0.687	15.1	687
	(0.011)	(0.013)	(0.013)			

NOTE: Figures in parentheses are standard errors.
*Significant at p = 0.01.
**Significant at p = 0.05.

[7]It is possible that the estimated differences between the winners and losers is biased downward as a result of regression to the mean over time. For a discussion of this issue, see Dranove and Cone (1985).

hospitals not yet on DRGs were not significantly different from changes exhibited by hospitals that were expecting to break even on DRGs.

Use of Hospital Inputs. In terms of the employment of LPNs, neither the hospitals expecting a loss nor those expecting a surplus acted significantly differently from the comparison group (see Table 3.14). However, hospitals expecting a surplus increased the employment of RNs per bed by 8.0 percent more than hospitals expecting to break even. Both hospitals expecting to win and lose on DRGs increased the number of beds relative to break-even hospitals with expected winners having a slightly larger response (3.4 percent compared with 2.6 percent).

SHARE hospitals increased LPNs per bed by 6.9 percent and per admission by 7.8 percent more than hospitals expecting to break even

Table 3.14

RESPONSES BY EXPECTED LOSERS AND EXPECTED WINNERS: REGRESSION RESULTS FOR USE OF PHYSICAL INPUTS

Dependent Variable	Parameter Estimates			Output Statistics		
	SHARE Hospitals	Expected Losers	Expected Winners	R^2	F	N
Total beds	0.003	0.026**	0.033*	0.988	560.0	690
	(0.011)	(0.013)	(0.013)			
Payroll and benefits per FTE	0.019	−0.036*	0.036*	0.623	11.0	660
	(0.014)	(0.017)	(0.017)			
Payroll and benefits per adjusted admission	0.023***	−0.091*	0.036*	0.899	60.0	667
	0.013)	(0.016)	(0.016)			
RNs per bed	−0.020	−0.031	0.077*	0.706	16.0	665
	(0.023)	(0.028)	(0.027)			
LPNs per bed	0.067***	0.031	0.001	0.836	33.0	645
	(0.037)	(0.043)	(0.042)			
LPNs per admission	0.075**	−0.005	−0.008**	0.820	29.3	646
	(0.037)	(0.044)	(0.043)			
LPNs per adjusted admission	0.090**	0.015	−0.014	0.811	27.0	636
	(0.038)	(0.046)	(0.045)			

NOTE: Figures in parentheses are standard errors.
*Significant at p = 0.01.
**Significant at p = 0.05.
***Significant at p = 0.10.

under DRGs. However, the employment of RNs and the number of total beds were not significantly different for SHARE hospitals.

Labor expenses can also be used as an indicator of the use of physical inputs. Two such measures were included: labor expense per full-time employee (FTE) and labor expense per adjusted admission.[8] Significant differences in the responses of hospitals with expected losses and those with expected gains can be seen. Compared with hospitals expecting to break even, hospitals with expected losses had lower labor expenses, whereas those with expected surpluses had higher labor expenses. Labor expense per adjusted admission was 8.7 percent lower and labor expense per FTE was 3.5 percent lower in hospitals expecting a loss. In hospitals expecting a surplus, labor expense per adjusted admission and per FTE were both 3.7 percent greater than in the comparison group. SHARE hospitals had slightly greater labor expenses per adjusted admission but not per FTE.

Table 3.15

RESPONSES BY EXPECTED LOSERS AND EXPECTED WINNERS: REGRESSION RESULTS FOR UNIT AND TOTAL EXPENSES

Dependent Variable	Parameter Estimates			Output Statistics		
	SHARE Hospitals	Expected Losers	Expected Winners	R^2	F	N
Expense per admission	0.010 (0.014)	−0.084* (0.017)	−0.007 (0.017)	0.858	41.5	685
Expense per adjusted admission	0.023 (0.015)	−0.089* (0.017)	−0.002 (0.017)	0.844	36.3	672
Expense per day	0.016 (0.013)	−0.031** (0.015)	−0.021 (0.015)	0.860	42.1	685
Expense per adjusted day	0.028** (0.013)	−0.036** (0.015)	0.027*** (0.015)	0.832	33.2	672
Total expenses	−0.001 (0.015)	−0.011 (0.017)	0.033*** (0.018)	0.984	414.8	685
Total expenses less physician expenses	0.010 (0.017)	−0.029 (0.022)	0.048** (0.023)	0.985	352.0	541

NOTE: Figures in parentheses are standard errors.
*Significant at p = 0.01.
**Significant at p = 0.05.
***Significant at p = 0.10.

[8]Labor expenses include both wages and benefits.

Unit and Total Expenses. Hospitals expecting a loss reduced their expenses compared with hospitals expecting to break even, whereas hospitals expecting a surplus either responded no differently or increased their expenses relative to the comparison group (see Table 3.15). Hospitals expecting a loss decreased their expense per admission by 8.1 percent and expense per inpatient day by 3.1 percent relative to the comparison group, whereas hospitals expecting a surplus increased expense per day by 2.1 percent (changes in expense per admission were not statistically different from the comparison group). Hospitals expecting a surplus increased total expenses by 3.4 percent and total nonphysician expenses by 4.9 percent, whereas hospitals expecting a loss did not show statistically different responses from the comparison group. Hospitals on the SHARE program increased expense per adjusted patient day by 2.8 percent more than the comparison group, but otherwise had similar changes in other expense measures.

Revenue Regressions. There were no statistically significant differences in total revenue (gross or net) between hospitals expecting to break even on DRGs and those expecting a loss or surplus (see Table 3.16). However, there were differences in terms of a unit revenue measure: Net revenue per adjusted admission was significantly lower in both hospitals expecting a loss (8.5 percent) and those expecting a surplus (5.5 percent) relative to break-even hospitals. SHARE hospitals had higher gross revenue (13.4 percent) and lower net revenue (3.5 percent) than the comparison group but no difference in net revenue per adjusted admission.

Why would there be a difference in net revenue per adjusted admission if there were no difference in total net revenues between hospitals expecting a loss or surplus and hospitals expecting to break even? Hospitals expecting losses or surpluses increased adjusted admissions more than hospitals expecting to break even. The change in the denominator of the unit revenue measure causes this measure to differ in the three hospital groups even though total revenue is nearly the same for all three groups.

SUMMARY OF FINDINGS

We contrast the effects of DRGs over all hospitals with the effects on hospitals expecting a surplus compared with those expecting a loss. Our empirical results indicate that although the DRG program had a number of significant effects on hospital behavior in New Jersey, it

Table 3.16

RESPONSES BY EXPECTED LOSERS AND EXPECTED WINNERS: REGRESSION RESULTS FOR REVENUE

Dependent Variable	Parameter Estimates			Output Statistics		
	SHARE Hospitals	Expected Losers	Expected Winners	R^2	F	N
Total gross revenue	0.126*	0.010	−0.036	0.971	232	673
	(0.019)	(0.024)	(0.024)			
Total net revenue	−0.036**	−0.004	−0.026	0.976	281	684
	(0.018)	(0.020)	(0.021)			
Net revenue per adjusted admission	−0.017	−0.089*	−0.057*	0.756	21	673
	(0.018)	(0.022)	(0.022)			

NOTE: Figures in parentheses are standard errors.
*Significant at p = 0.01.
**Significant at p = 0.05.

appears that it did not lead to reductions either in total expenses incurred by hospitals or in total net revenue collected by hospitals.

Aggregate Hospital Responses

On average, significant reductions in unit costs were achieved under the DRG program. Average cost per admission and per adjusted admission fell by an estimated 4.7 percent and 6.2 percent, respectively. Reductions occurred in cost per patient day and cost per adjusted patient day (1.3 and 2.9 percent). Introduction of DRGs influenced the use of some inputs by hospitals. Labor expense per adjusted admission and per adjusted patient day fell by 4.7 percent and 1.4 percent, respectively. Hospitals reduced the number of LPNs per bed by 4.7 percent but did not reduce the number of RNs per bed, nor did they reduce the average number of staffed beds. Despite significant reductions in unit costs, total hospital expenses were not reduced by the DRG program. To understand these results it is necessary to review our findings on hospital utilization.

A 3.1 percent reduction in the average length of stay did not translate into a significant decline in total inpatient days in the hospital. Potential reductions in the number of inpatient days were offset by increases in the number of admissions. Total admissions and total adjusted admissions increased by 3.6 percent and 5.3 percent,

respectively. Some of these additional admissions may have come at the expense of outpatient clinics as total outpatient visits fell by an estimated 7.9 percent. Because increased admissions offset decreases in average length of stay and because hospitals did not significantly alter bed capacity, occupancy rates remained unchanged.

Total gross outpatient revenue fell by 10.1 percent, and total gross revenue fell by 16.8 percent. Hospitals experienced a reduction in net revenue per adjusted admission of 3.4 percent. However, the DRG program had no measurable impact on total net revenue.

Hospital Responses by Expected Financial Position

Table 3.17 summarizes the results of the multivariate regressions by reporting the coefficients for expected winners and losers, as well as the difference between the two groups. Hospitals expecting a loss under DRGs acted more strongly to increase admissions and outpatient use and decrease expenses: They increased admissions by 7.5 percent relative to hospitals expecting to break even, whereas hospitals expecting a surplus increased admissions by 4.4 percent. They reduced expense per admission (8.1 percent) and per day (3.1 percent), whereas hospitals expecting a surplus showed no reductions in expense per admission and a significant increase in expense per adjusted patient day (2.7 percent). The decrease in expenses for hospitals expecting a loss resulted from both a reduction in average length of stay (5.2 percent) and a reduction in labor input costs (8.7 percent for labor expense per adjusted admission and 3.5 percent for expense per FTE). Total revenue (net or gross) did not significantly differ for hospitals expecting a loss and hospitals expecting to break even.

Hospitals expecting a surplus did not act to constrain costs to maximize profits. They increased both expense per adjusted day and total expenses by about 3 percent relative to hospitals expecting to break even. They significantly increased both the number of beds (3.4 percent) and the number of RNs per bed (8.0 percent). Their higher investment in labor costs is reflected by the increase in labor expense per FTE (3.7 percent) and per adjusted admission (3.7 percent). The economic incentives imposed by the DRG payment system did not produce a uniform hospital response. Hospitals differed in their behavior depending on their expected financial position under the system.

Table 3.17

COMPARISON OF ESTIMATED REGRESSION COEFFICIENTS FOR LOSER AND WINNER HOSPITALS

Dependent Variables	Expected Losers	Expected Winners	Difference
Utilization			
Average length of stay	−0.053	−0.026	−0.027
Admissions	0.072	0.043	0.029
Adjusted admissions	0.081	0.032	0.049
Inpatient days	0.020	0.016	0.004
Occupancy rate	−0.005	−0.016	0.011
Unit and Total Expense			
Expense per admission	−0.084	−0.007	−0.077
Expense per adjusted admission	−0.089	−0.002	−0.087
Expense per day	−0.031	0.021	−0.052
Expense per adjusted day	−0.036	0.027	−0.063
Total expenses	−0.011	0.033	−0.044
Expenses less physican expenses	−0.029	0.048	−0.077
Physical Inputs			
Total beds	0.026	0.033	−0.007
LPNs per bed	0.031	0.001	0.03
RNs per bed	−0.031	0.077	−0.108
LPNs per admission	−0.005	−0.008	0.003
LPNs per adjusted admission	0.015	−0.014	0.029
Payroll and benefits per FTE	−0.036	0.036	−0.072
Payroll and benefits per adjusted admission	−0.091	0.036	−0.127
Revenue			
Total gross revenue	0.010	−0.036	0.046
Total net revenue	−0.004	−0.026	0.022
Net revenue per adjusted admission	−0.089	−0.057	−0.032

IV. DO HOSPITALS ALTER THE PAYOR MIX OF THEIR ADMISSIONS?

In this section we examine differences in hospital resource use and profitability by payment source. We then identify a subset of DRGs in which a majority of Medicare patients incur financial losses. The higher resource use of Medicare patients provides hospitals with an incentive to selectively alter patient mix within these DRGs by limiting Medicare admissions. We compare the distribution of patients across hospitals between 1979 and 1982 to determine whether providers have altered the admission patterns of patients in these DRGs.

The incentives of the New Jersey all-payor system are determined by the design of the rate-setting methodology. It is a fixed price payment system that sets 467 prices (one price per DRG) for each hospital.[1] The payment rate for each DRG is designed to reflect average resource use within the DRG. It is partly based on the industry-wide average cost[2] of treating all patients in the DRG in the state and partly on the individual hospital's average cost of treating patients in the DRG. By not basing payments solely on the individual hospital's average cost experience, the rate-setting system induces hospitals to increase their efficiency.

The payment rate is set such that it covers the costs of the "average" patient. By design then, some patients in a DRG will incur costs that exceed the payment rate, and others will incur costs below the payment rate. With a random distribution of inexpensive and expensive patients across hospitals, no policy issue arises. However, if the distribution of patients is nonrandom, two issues are raised: (1) access to hospital care for expensive patients, and (2) the fairness of payments to a hospital. Hospitals that successfully attract cheaper patients or actively discourage the admission of expensive patients will benefit financially. If there are characteristics of patients that predict expense but are not taken into account by the payment mechanism, they can be used to discriminate, thus jeopardizing access to hospital care for some patients. As to the fairness of rates, if some hospitals treat patients who consistently have above average costs, they will incur losses. Over the long term, their financial viability may be

[1]Reimbursement for DRGs 468–470 (ungroupable cases) and DRGs 471–476 (outliers) is based on incurred charges.

[2]Averages are calculated separately for three groups of hospitals on the basis of teaching level.

threatened, not because of inefficiency, but because of their patient mix.

If it is not possible to predict before admission which patients will have above average costs, then the access issue becomes less relevant. However, the fairness issue remains. The ability to predict which patients will have higher than average costs is tied to the performance of DRGs in explaining variation in costs. Variation that is not explained by DRGs is important if it can be correlated with patient characteristics. Worthman and Cretin (1986) reviewed studies of the performance of DRGs in predicting costs or charges and report that between 26 and 48 percent of the variation is explained using trimmed data[3] (Mitchell et al., 1984; Mitchell et al., 1985; and West et al., 1985). However, surgical DRGs provided most of the explanatory power, explaining from 48 to 57 percent of the variation in costs. Nonsurgical DRGs explained only 7 to 16 percent of the variation in costs (Mitchell et al., 1984; Mitchell et al., 1985; West et al., 1985; and Frank and Lave, 1985).

Several researchers including Horn et al. (1984) report that DRGs do not successfully capture severity of illness differences between patients. If DRGs inadequately adjust for severity differences, then patient characteristics that help to explain such differences may be used to identify patients likely to incur higher than average costs. Characteristics likely to be helpful in explaining severity differences include admission status (discussed in the next section), age, and the presence of particular comorbidities.

We select Medicare status as a factor that may predict higher than average resource use under an all-payor system. Because of the categorical nature of this public financing program, which is designed to cover the segment of the population that is aged, permanently disabled, or afflicted with end stage renal disease, Medicare status is correlated with patient characteristics, such as age and comorbidity, that predict higher costs. Moreover, Medicare status is an easily identifiable characteristic that is known before admission.

Under New Jersey's rate-setting system, a hospital's schedule of DRG reimbursement rates is payor-specific but the rates are nearly the same for all payors.[4] Therefore, a hospital receives nearly the same DRG payment for a Medicare patient as for a Blue Cross or commercially insured patient. If Medicare patients are found to be more costly compared to privately insured patients, hospitals may gain financially

[3]Trimmed data exclude outliers.

[4]A small discount is awarded to Blue Cross, Medicare, and Medicaid for claims processing efficiencies and prompt payments. Blue Cross receives a 6.18 percent discount, Medicare 2.66 percent, and Medicaid 2.65 percent.

by limiting the more expensive Medicare admissions. Because the Medicare population accounts for a large portion of hospitals' business (approximately one-fourth of the patients and 40 percent of the revenue), hospitals will not likely discourage the admissions of all Medicare patients. However, there may be selected DRGs in which the costs of Medicare patients are substantially higher than the costs of privately insured patients.

The DRG-based rate-setting system gives hospitals an incentive to reduce the average cost per patient. Hospitals may attempt to do so in several ways: (1) improve efficiency; (2) reduce the costs of inputs; (3) provide fewer services per admission; (4) unbundle services by moving more of them out of the hospital (e.g., preadmission testing or post-discharge home health services). As an alternative or supplement to these approaches, hospitals may attempt to alter patient mix so that their patients are less severely ill. To reduce the average severity of illness level within DRGs, hospitals can either increase admissions of less severely ill patients or discourage admissions of more severely ill patients.

The objectives of this analysis are twofold. The first is to determine whether there are differences in resource use and profitability across payors. In particular, are Medicare patients more costly than privately insured patients after controlling for DRG and hospital teaching status? If such differences are found to exist, the second part of our analysis examines whether hospitals attempt to alter patient mix by selectively discouraging admissions of Medicare patients.

Discouraging admissions of higher than average cost patients is one type of patient dumping. Other types of dumping activity may involve patients who are admitted to a hospital and are transferred to other acute care facilities for financial rather than medical reasons or discharged before it is medically appropriate. This analysis investigates only the first type of dumping behavior—that of discouraging admissions.

RESEARCH QUESTIONS

Two questions were addressed:

- Are there differences in resource use and profitability by payor after controlling for DRG and hospital teaching status?
- Are there DRGs in which the majority of Medicare patients are unprofitable? Is there any evidence that hospitals discourage the admission of Medicare patients in these DRGs?

DATA SOURCES AND METHODOLOGICAL APPROACH

Data Sources

The New Jersey Department of Health provided two sources of data: the Uniform Bill-Patient Summary (UB-PS) file, which is a hospital discharge dataset, and the Schedule of DRG Rates, which consists of payment rates for hospitals. Data were obtained for 1979, the year before implementation of the rate-setting system and 1982, the third year of the system.

The 1979 sample includes discharges for 80 acute care hospitals in New Jersey, whereas the 1982 sample contains discharges for 96 hospitals. Because the analyses involve comparisons between 1979 and 1982, we limited the set of hospitals to the 80 that provided data in both years.[5]

The sample of 80 hospitals was similar to the 96 hospitals in terms of teaching status (major teaching 23 and 22 percent, respectively; minor teaching 15 and 13 percent), location (inner city 23 and 21 percent; urban 28 and 27 percent; suburban 37 percent for both), and payor mix (an average of 28 and 31 percent, respectively, of discharges attributed to Medicare, 10 percent to Medicaid, and 7 percent to self pay patients). The major difference between the sample of 80 and the full set of 96 hospitals is in terms of the year that the hospitals entered the all-payor rate-setting system. All the non-reporting hospitals in 1979 adopted the rate-setting system in the third year of implementation, 1982. Of the hospitals that reported data in 1979, 22 percent entered the all-payor system in 1982 compared to 36 percent in the full set of 96 hospitals.

The UB-PS file consists of records for discharges from acute care hospitals in the state. It contains both clinical and financial information, including the following: age, sex, admission status, payment source, length of stay, the trimmed and untrimmed DRG category (as it was assigned by the NJDOH),[6] the admitting hospital cost per day, and cost for the entire stay.

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[5]The data for several small multi-hospital systems (two or three hospitals located in the same area) were each combined into a single hospital reporting unit by the NJDOH. Therefore, the actual number of hospital reporting units in the sample is 74, instead of 80.

[6]The 470 revised DRGs (based on the *International Classification of Diseases,* 9th Revision) were used throughout the study even though in 1980 New Jersey's system used the 383 original DRGs (based on the *International Classification of Diseases,* 8th Revision). At the time that New Jersey converted to the revised DRG classification system, it reassigned the DRG category for discharges in earlier years, computed payment rates retroactively to 1979, and redefined outliers.

The cost estimates on the UB-PS file are derived from recorded hospital charges for both direct and indirect patient care services. Accommodation charges were reduced to costs by applying hospital-specific, cost-to-charge ratios for routine care costs. Ancillary charges were reduced to costs using each hospital's departmental-specific, cost-to-charge ratios.[7]

Differences in the price of hospital inputs, as measured by wage differentials across hospitals, are removed. Leveled costs per admission are calculated by multiplying the full cost per admission by a wage equalization factor, calculated by the NJDOH. The equalization factor is calculated for each of eight labor categories by dividing labor costs per hour for all New Jersey hospitals by the average hourly cost for the hospital. A hospital's overall equalization factor is calculated by dividing total equalized costs by total actual costs.

In calculating hospital costs, we did not include any hospital-based physician costs, even if the hospital charges included such services because hospitals differ in the way in which they reimburse such physicians. In some hospitals, charges for the services of radiologists, anesthesiologists, and pathologists (RAPs) are included in the hospital charges (and the RAPs are reimbursed in turn by the hospital). In other hospitals, these physicians bill independently, and so their charges do not appear in the hospital bill. By including hospital costs for RAPs, some hospitals may appear to have higher costs solely because physician charges appear in the hospital bill.

The Schedule of DRG Rates includes hospital-specific, DRG payment rates for 1979 and 1982. Even though the all-payor rate-setting system was not implemented until 1980, the NJDOH used 1979 as the base year in which to calculate hospital-specific rates. Therefore, rates were calculated for this year as if hospitals were on the system.

We calculated the expected profit for *each* inlier patient in 1979 by subtracting the patient care costs obtained from the discharge file from the expected revenue (payment rate) obtained from the Schedule of Rates.[8] By "expected profit," we mean the net income (or loss) that

[7]The cost-to-charge ratios were calculated by the NJDOH from audited annual cost reports submitted by hospitals. The ratios were developed using an accounting approach to allocate all direct patient care costs to an individual cost center. Costs for nonrevenue-producing cost centers (laundry, dietary, etc.) were allocated to revenue-producing centers using standard step-down cost allocation procedures. Because of joint production, some services may be associated with more than one cost center. The costs of such services were allocated to cost centers according to the proportion of the services delivered through the cost center. This allocation of joint costs is arbitrary and introduces some error into our analysis.

[8]Expected profits were calculated for inlier patients only. Because hospitals are reimbursed on the basis of "controlled charges" (which are intended to reflect hospital costs) for outlier patients, we assumed that the expected profit for outliers was essentially zero.

the hospital would have incurred had it been on DRGs in 1979. In using 1979 data, we are assuming that hospital responses to the incentives of the fixed price payment system depend on the types of patients that would have generated losses at the time the new system was implemented. In so doing, we identify patient groups that could be expected to incur losses under the rate-setting system if treatment patterns remained unchanged. We can then follow these patient groups in 1982 to determine whether hospitals altered their admission patterns.

Differences in Resource Use by Payor

As with the rest of our study, we confine our analysis of payor differences in resource use to hospital inpatient services only. We use regression analysis (ordinary least squares) to estimate resource use by payor. Our model controls for two factors that are incorporated into the payment system, namely, the patient's DRG classification and the hospital's teaching status. The general form of our model is as follows:

$$\text{RESOURCE USE} = b_0 + b_{1-466}\text{DRG} + b_{467-468}\text{TEACH} + b_{469-471}\text{PAYOR}$$

The functional form of the model is log linear. Because of the skewed distribution of the dependent variables, they were transformed by taking the natural logarithm of each.[9] This transformation avoids giving undue weight to patients with large values of the dependent variable.

Two sets of regressions were run: The first included outlier patients as well as inlier patients; the second included only inlier patients. Because there are differences in the proportion of a payor's patients who fall into an outlier category, we included outliers in our initial estimation of resource use differences by payor. However, because outliers fall outside the purview of the prospectively determined payment rates, separate estimates were made for only those patients for whom hospitals are placed at risk (i.e., inliers).

Selection of Dependent Variables. As one measure of resource use, we selected the direct patient care cost per admission. Differences in cost per admission can be attributed to differences in length of stay or to differences in the cost per day. We included length of stay as well as cost per admission because it is a measure of resource use not subject to the errors arising from the cost allocation procedures.

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[9]Observations in which cost per admission was equal to zero were dropped from our analysis. A constant (one) was added to LOS to avoid taking the natural logarithm of zero. The log of profit was taken as the log of payment divided by cost.

In addition to measuring resource use differences by payor, we examined expected profitability by payor. Expected profit was selected as a dependent variable because it measures the actual incentives facing hospitals. DRG payment rates are partially determined by the individual hospital's cost function and so are hospital-specific.[10] Even that part of the payment rate that is based on industry-wide average costs differs by the teaching status of the hospital. Because the payment rates are not the same for all hospitals, cost differences, in and of themselves, do not necessarily reflect the incentives facing hospitals. For example, patients in DRG 9 (spinal disorders and injuries) may be more costly to treat in a teaching hospital than in a nonteaching hospital, but they may be no less profitable in the teaching hospital, since the hospital could be receiving a higher payment rate.

If in responding to the DRG payment system, hospitals attempted to identify profitable and unprofitable DRGs or patients, the use of expected profit should reveal the incentives facing hospitals at the time that DRGs were first implemented in New Jersey. One potential problem is that not all hospitals entered the DRG system in 1980. Therefore, the incentives faced by hospitals in 1979 (which we measure) may have changed by 1981 or 1982 when some hospitals were brought into the system. However, if the introduction of DRGs into one-fourth of the state's hospitals in 1980 produced an anticipatory effect on hospitals not yet on the system, the incentives we capture by measuring expected profit in 1979 may have, at least partially, driven hospital behavior.

Selection of Explanatory Variables. The model estimates resource differences by payor. Five categories of payors were defined: Medicare, Medicaid, self pay, Blue Cross and commercially insured, and other. The other category includes patients enrolled in health maintenance organizations (HMOs) or covered by miscellaneous programs, such as Title V (Maternal and Child Health), no fault automobile insurance, and Workers' Compensation. Dichotomous variables were created for four payor categories: MEDICARE, MEDICAID, SELFPAY, and OTHER.[11] Each variable equals 1 if the category represents the patient's primary payor and 0 otherwise. Commercially insured and Blue Cross patients form the comparison group.

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[10]As was discussed in Sec. II, the weight placed on the individual hospital's cost function in determining the payment rate varies by DRG.

[11]The coefficient of a dichotomous variable in a log-linear regression can be transformed into a measure of the percentage difference between the identified group and the omitted group. The transformation is $exp(b) - 1$, where b is the estimated coefficient.

The model controls for two variables used in determining payment rates for hospital care, namely, DRG and the teaching status of the admitting hospital. A separate dichotomous variable was used to control for each DRG. Each DRG dummy variable equals 1 if a patient is assigned to the corresponding DRG and 0 otherwise.

Two dichotomous variables were created to control for teaching status: MAJTEACH and MINTEACH, which represent major teaching and minor teaching hospitals, respectively. Nonteaching hospitals serve as the comparison group.

To test whether our model omits important correlates of payment source, we ran regressions which adjusted for all hospital-specific fixed effects by including a dummy variable for all but one hospital. These regressions resulted in no significant change in the size of the Medicare coefficient, the payor of interest in this analysis. Therefore, we report only the results of the analyses using DRG, hospital teaching status, and payment source.

Analysis of Dumping Behavior for Selected DRGs

The regression analyses provide summary measures of the differences in resource use between payor classes. The analyses showed that Medicare patients tend to be more costly and less profitable than Blue Cross and commercially insured patients after controlling for DRG and hospital teaching status. To compare differences in resource use at an individual DRG level and to enable the selection of high-risk DRGs, the average and median profit were calculated separately for Medicare and non-Medicare patients within each DRG.

By high risk DRGs we mean DRGs likely to be targets of Medicare dumping activity, if indeed it exists. They are DRGs in which Medicare patients are unprofitable compared to other patients. Selected DRGs had to satisfy the following criteria:

- The median expected profit for Medicare patients was less than −$15, meaning that over one-half of Medicare patients generated a loss of at least $15.
- The median expected profit for non-Medicare patients was positive.
- At least 100 discharges were each attributed to Medicare patients and non-Medicare patients.

In the DRGs selected by the above criteria, Medicare patients showed both an average loss and a median loss. The criterion for a median loss was added because the distribution of the profit variable makes it possible for the average to be negative, while the median is

positive. In this case, even though Medicare patients show a loss on average, over half of the Medicare patients generate a gain. Hospitals may have less of an incentive to discourage admissions of Medicare patients in these DRGs. To facilitate our ability to detect "dumping" activity, the selection of DRGs was limited to those in which it would be most likely to occur.

If dumping of Medicare patients as a payor class had occurred in the selected DRGs, Medicare admissions across the state would likely be concentrated in fewer hospitals in 1982 as compared to 1979. We compare the distribution of Medicare patients in selected DRGs across hospitals in these two years. In so doing, we are searching for evidence that dumping had occurred and not for individual incidents of patient dumping.

EMPIRICAL RESULTS

Estimation of Differences in Resource Use by Payor

Using regression analysis, we examined differences in LOS, cost per admission, and profitability by payor. Table 4.1 presents the results. In the top half of the table, the resource differences were estimated for both inliers and outliers, and in the bottom half, differences were estimated for inliers only.

After controlling for the patient's DRG classification and hospital teaching status, differences in resource use and profitability by payor remain. Transforming the coefficients reveals that Medicare patients stay 28.2 percent longer on average than the privately insured when the comparison is made over all (inlier and outlier) patients. The longer LOS is reflected in higher costs per admission (24.2 percent). As a result of the longer LOS and higher cost per admission, Medicare patients are 4.5 percent less profitable than privately insured patients.

When limiting the comparison to just inlier patients, we see that the increases in LOS and cost per admission for Medicare patients are smaller. It is useful to examine differences for the inlier patients, since they constitute the set of patients for whom hospitals are "at-risk." Medicare LOS is still 13.9 percent longer, cost per admission is 11.4 percent greater, and profitability is 5.4 percent less than for Blue Cross and commercially insured inlier patients.

Medicaid patients stay 10.4 percent longer and cost 6.2 percent more on average than the privately insured when including inliers and outliers. When considering only inliers, the average cost per admission for Medicaid is slightly less than that for privately insured patients.

Table 4.1

REGRESSION RESULTS: EFFECTS OF PAYOR STATUS ON HOSPITAL LOS, COST PER ADMISSION, AND PROFITABILITY, NEW JERSEY, 1979

Dependent Variable	Coefficients						Output Statistics	
	Major Teaching Hospital	Minor Teaching Hospital	Medicare	Medicaid	Self Pay	Other Pay	R^2	F
Inliers and Outliers (N = 215,338)								
Length of stay	0.012*	−0.019*	0.249*	0.099*	−0.025*	−0.002	0.461	389
	(0.003)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)		
Cost per admission	0.136*	0.016*	0.217*	0.060*	0.0002	0.009	0.489	435
	(0.003)	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)		
Profit	0.010*	0.011*	−0.046*	−0.003	0.006**	−0.006**	0.016	7
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)		
Inliers (N = 171,276)								
Length of stay	0.003	−0.013*	0.130*	0.026*	−0.023*	0.003	0.623	601
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)		
Cost per admission	0.120*	0.019*	0.108*	0.012*	0.001	0.014*	0.611	571
	(0.002)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)		
Profit	0.015*	0.015*	−0.056*	−0.003	0.014*	−0.004	0.020	7
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)		

NOTES: Standard errors are in parentheses. The coefficents can be transformed into a measure of the elasticity of the dependent variable with respect to the independent variable by the following equation: $exp(b) - 1$.

In calculating the average expected profit for self pay patients, the assumption is made that hospitals receive the DRG payment rate for such patients (even though self pay patients are a major source of bad debt and charity care). Although in 1979 hospitals did not receive payment for bad debt and charity care, they did so under the all-payor system. The intent here is to compare the average cost with the hospital's reimbursement rate.

*Significant at 0.01 level.

**Significant at 0.10 level.

The average profitability of Medicaid patients is not significantly different from that of privately insured patients.[12]

Although self pay patients had shorter stays (by 2.5 percent) than the privately insured, their average cost per admission did not differ significantly from that of privately insured patients over both inliers

[12]The finding that Medicaid patients are not any less profitable, even though they are more costly may be a result of admissions to more costly hospitals for which the hospital-specific component of reimbursement is higher, or to teaching hospitals, which have a higher payment rate.

and outliers. If hospitals had received DRG reimbursement for self pay patients in 1979, such patients would have been 0.6 percent more profitable than privately insured patients (and 1.4 percent more profitable when comparing inlier patients only). The slightly higher profitability of self pay patients may have been due to hospitals' efforts to control the costs of patients for which they were less likely to receive full reimbursement.

The Evidence on Dumping of Medicare Patients: A DRG-Level Analysis

Selection of High Risk DRGs. Because Medicare patients are less profitable than other patients, they may be likely targets for hospitals wishing to limit admissions of more costly patients. To search for evidence of dumping behavior, we identified individual DRGs in which Medicare patients would generate losses and non-Medicare patients would generate surpluses (if hospitals were being paid by DRG rates in 1979). The selection criteria were described in the methodology subsection. The DRGs of concern are ones for which a payment rate is established and that contain both Medicare and non-Medicare admissions. If a DRG contains only Medicare patients, its payment rate should reflect the average treatment costs, and there should be no incentive to dump Medicare patients as a class. Of the DRGs with payment rates, 172 contain at least 100 Medicare and 100 non-Medicare inlier patients, statewide.

For each of the 172 DRGs, comparisons were made of differences in average length of stay, cost, and expected profitability between Medicare and non-Medicare patients in 1979. The results are consistent with the regression analyses that measure the differences over all DRGs. In general, average length of stay and cost within individual DRGs are greater for Medicare patients.

In 67 percent of the 172 DRGs, Medicare patients show an average expected loss, whereas non-Medicare patients show an average expected surplus. Only DRGs in which Medicare patients generated an expected median loss[13] of at least $15 were considered as DRGs in which Medicare patients would have a high risk of not being admitted by hospitals that practice dumping.

Eight DRGs were selected as likely targets of dumping behavior. The incentives to dump Medicare patients are likely to be strongest in this set of DRGs. Consequently, our ability to detect dumping behavior, if it occurs, is likely to be greatest with this group of DRGs.

[13]Based on direct patient care costs in 1979 dollars.

Table 4.2 lists the eight DRGS, the number of discharges in 1979, and the expected profits for Medicare and non-Medicare patients.

Evidence of Patient Dumping Behavior. If some hospitals respond to the incentives of the DRG-based payment system by

Table 4.2

SELECTED TARGET DRGS: THE MEDIAN PROFIT FOR MEDICARE PATIENTS IS NEGATIVE

DRG	Description	No. of Discharges		Average Profit per Discharge			
				Medicare		Other	
		Medicare	Other	Mean (Std)	50th Percentile	Mean (Std)	50th Percentile
215	Back and neck procedures, <70, w/o CC[a]	106	1756	−261 (644)	−221	29 (619)	84
149	Major bowel procedures, ≥70 or CC	249	1049	−144 (606)	− 67	32 (715)	116
198	Total cholecystectomy w/o CDC,[b] <70, w/o CC	371	4077	−134 (362)	− 43	1 (307)	78
204	Disorders of pancreas except malignancy	376	1703	−126 (490)	− 76	33 (408)	115
430	Psychoses	1313	5046	−119 (577)	− 37	21 (541)	112
421	Viral illness ≥18	139	911	−109 (343)	− 19	21 (283)	72
90	Simple pneumonia and pleurisy, 18–69, w/o CC	318	2912	−102 (442)	− 24	11 (373)	87
247	Signs/symptoms of musculoskeletal system and connective tissue	129	841	−81 (287)	− 26	28 (274)	49

NOTE: Profits are in 1979 dollars. To obtain 1987 dollars, multiply by 1.928. The adjustment factor is based on the medical care component of the Consumer Price Index. This table omits data from seven of the 80 hospitals.

[a]CC refers to comorbidities and/or complications.

[b]CDC refers to common bile duct exploration.

dumping Medicare patients in loser DRGs, we would expect to see a relatively smaller number of hospitals treating Medicare patients for these DRGs after implementation of the new payment system. We examined the statewide distribution of Medicare patients to determine whether Medicare patients became increasingly concentrated in fewer hospitals in 1982 as compared to 1979. As a control for overall changes in the distribution of the total population in New Jersey, we also examined changes in the distribution of non-Medicare patients in the same set of DRGs.

Table 4.3 shows the changes in the distribution of Medicare and non-Medicare patients between 1979 and 1982. The table is presented in terms of cumulative percentages: It shows the cumulative percentage of hospitals that serve a cumulative percentage of discharges. Hospitals are first sorted in descending order of the number of Medicare patients (or non-Medicare patients) admitted for the eight selected DRGs. The first hospital has the highest number of Medicare patients for the set of eight DRGs in the state, the second hospital has the second highest number of Medicare patients, and so on. Then the cumulative percentages are calculated. For example, in 1979, the top 10 percent of the hospitals (in terms of Medicare admissions) treated 27.4 percent of the Medicare patients, whereas the top 10 percent (in terms of non-Medicare admissions) treated 22.6 percent of the non-Medicare patients.

Instead of becoming more concentrated as would be expected if widespread patient dumping had occurred, Medicare patients became slightly less concentrated. For example, in 1979, 10 percent of the hospitals in our sample treated 27.4 percent of the Medicare patients in the selected DRGs as compared to 25.2 percent in 1982. The distribution of Medicare patients is slightly more concentrated than the distribution of non-Medicare patients. In 1979, 25 percent of the hospitals treated 53.1 percent of the Medicare patients and 46.2 percent of the non-Medicare patients. The relative difference in the concentration of Medicare versus non-Medicare patients did not change much between 1979 and 1982.

A graphic technique for summarizing the information in a concentration table is the Lorenz curve, which is a continuous function that shows the percentage of discharges accounted for by any given fraction of the total hospital industry.

Figures 4.1 and 4.2 present the data in the form of Lorenz curves. Figure 4.1 illustrates the distribution of Medicare patients in the set of eight DRGs; Fig. 4.2 illustrates the distribution of non-Medicare patients. The cumulative percentage of discharges is on the abscissa, and the cumulative percentage of hospitals is on the ordinate. Data for

Table 4.3

CHANGES IN THE DISTRIBUTION OF MEDICARE AND NON-MEDICARE PATIENTS IN EIGHT TARGET DRGS: 90, 149, 198, 204, 215, 247, 421, AND 430, NEW JERSEY, 1982

Percentage of Hospitals	Cumulative Percentage of Discharges			
	Medicare		Non-Medicare	
	1979	1982	1979	1982
10	27.4	25.2	22.6	21.4
25	53.1	50.1	46.2	44.8
50	77.9	78.4	74.4	74.6
75	92.7	92.8	91.3	91.5
90	98.0	98.0	97.5	97.3

NOTE: If widespread dumping of Medicare patients had occurred, one would expect to observe an increased concentration of Medicare patients across hospitals.

1982 are overlaid on data for 1979, so that a comparison can be made between the two years. As can be seen, there was little change in the distribution of patients for either payor group between 1979 and 1982. At the aggregate level, the data do not provide evidence of widespread dumping of Medicare patients in the set of target DRGs selected.

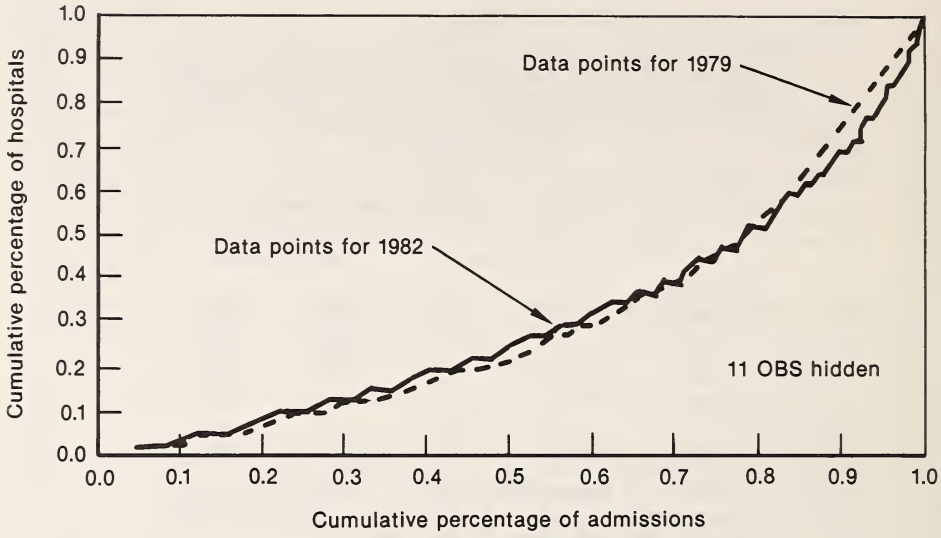

Fig. 4.1.—Changes in distribution of Medicare admissions across hospitals, 1979-1982

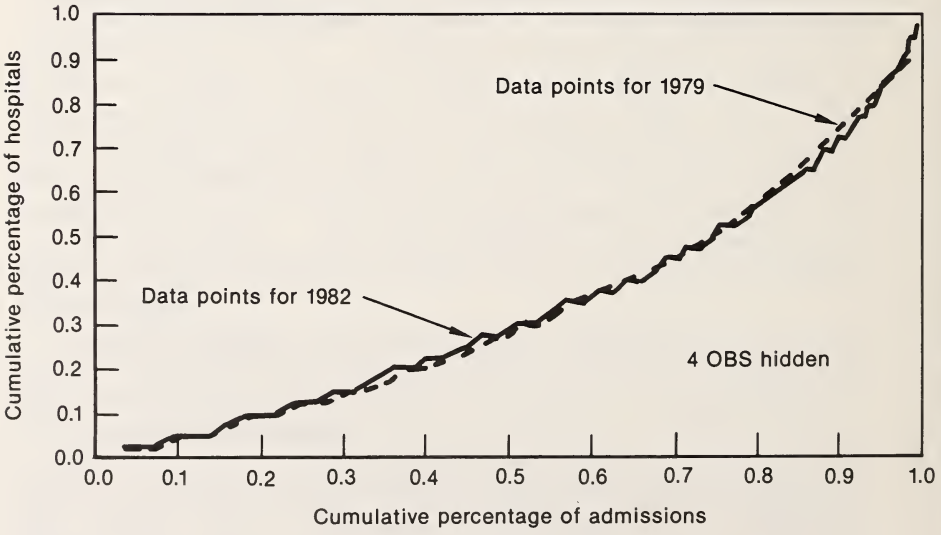

Fig. 4.2—Changes in distribution of non-Medicare admissions across hospitals, 1979–1982

V. HOSPITAL PAYMENTS UNDER DRGS: SHOULD EMERGENCY ADMISSIONS HAVE HIGHER RATES?

INTRODUCTION

Systematic variation in patient resource use and costs not captured by DRGs can be a significant shortcoming of a DRG-based prospective payment system. The underlying assumption of the DRG-based case mix classification system is that patients in the same DRG consume relatively equal amounts of resources. If resource use varies systematically by factors ignored by the classification system, and if patients exhibiting these factors are unevenly distributed across hospitals, the reimbursement system may unfairly penalize hospitals with a larger proportion of such patients. Such hospitals will be underpaid relative to the average resource requirements of their patients. Over the long term, the financial viability of these hospitals may be threatened, not because they are more inefficient, but because of their mix of patients.

In this section, we examine whether patients who are admitted on an emergency or urgent basis represent an identifiable group of patients whose costs are systematically higher than electively admitted patients within a DRG. The hypothesis that nonelective admissions require more inpatient resources is based on several factors. First, emergency admissions, because they are unplanned, limit the range of options available to physicians. Diagnosis and treatment begin only after the emergency patient is in the hospital. In contrast, the physician of a patient admitted on an elective basis has the opportunity to plan resource use more rationally. Physicians tend to have more information for such patients and so are able to expend fewer hospital resources in determining the problem and mapping out a course of treatment.

A second source of hospital cost savings may arise if it is possible to begin diagnosis or even treatment before admission by using outpatient services. This approach might lead to reduced costs for diagnostic services during the inpatient stay or a reduced length of stay. Surgical admissions may be particularly amenable to inpatient hospital cost savings through outpatient substitution. If it is not more efficient to provide such services in an outpatient setting, this substitution does not necessarily result in total cost savings, only lower inpatient costs.

Third, emergency admissions may require more resources if such admissions reflect a higher severity of illness level. Patients admitted on an emergency basis may be concentrated in more serious diagnoses within a DRG and may be more acutely ill than electively admitted patients in the same DRG. Patients admitted on an elective basis may be less likely to have secondary diagnoses, comorbidities, or other complications that may increase treatment requirements.

Previous Empirical Studies

The existing literature on patient-level analyses of the relative cost of emergency admissions controlling for case mix is quite sparse. One study estimated the total costs, expected reimbursement, and expected profit under Medicare's PPS for DRGs with a high percentage of emergency admissions (Munoz et al., 1985). They found that the expected net profit for these DRGs is negative under the PPS program and thus concluded that hospitals with emergency departments will not fare well under PPS. For purposes of making policy, this study is quite limited. The most important drawback stems from limitations in the sample used for the study: The data were drawn from a single hospital. Thus one cannot be sure that the findings reflect a general pattern or if they are merely specific to the hospital studied.

A second study, also conducted by Munoz et al. (1986), compared the cost of admissions from hospital emergency rooms with a matched sample of nonemergency-room admitted patients within the same DRGs. This study found that the cost of emergency admissions exceeded the cost of nonemergency admissions within the same DRG in more than 70 percent of the DRGs. The data for this study were drawn from the 11 hospitals in the New York City Health and Hospitals Corporation. Again, one cannot be sure whether the finding of greater costs for emergency admissions within a DRG is generalizable or if it is limited to the 11 large inner-city hospitals in this system, which represent only one segment of the hospital industry in New York.

Study Objectives

The objectives of this analysis are twofold. The first is to determine whether patients admitted on an emergency or urgent basis use inpatient resources differently from elective patients in the same DRG. Specifically, we examine whether differences in resource use can be partially explained by differences in admission status. We are interested in both the aggregate effect across all DRGs and in a DRG-

specific effect. For example, if a significant effect were found using data aggregated across all DRGs, we would then want to know whether the effect is similar for each DRG or whether it varies by DRG. Because significant differences are found between emergency and urgent admissions and elective admissions, the second part of our analysis explores whether incorporating information on admission status into the DRG classification system improves the system's ability to explain variation in costs.

Even if admission status were valuable in improving the ability to predict resource use, there are limitations to its usefulness as an adjustor for reimbursement purposes. Since the criteria for coding admission status are somewhat subjective, providers would have both an incentive and an opportunity to recode at least some elective admissions to either urgent or emergency status, thereby increasing revenue. Nevertheless, it is important to understand the association between admission status and costs because it affects the fairness of hospital payment rates. Moreover, it points to a potential weakness in the DRG classification system. For example, if patients admitted on an emergency basis are indeed more expensive, then hospitals will have an incentive to limit such admissions.

DATA SOURCES AND METHODOLOGICAL APPROACH

Data

The sample includes all inpatient discharges in 1982 from 96 of the 98 short-term, acute care hospitals in New Jersey.[1] The discharge data and the derivation of the cost estimates are described in Sec. IV. Our analysis estimates the effect of admission status on inpatient hospital resource use. Resource use is measured by inpatient cost per admission, length of stay, and inpatient cost per day. Only measures of hospital inpatient costs are included. Physician costs for inpatient services are not included. Differences in the price of hospital inputs, as measured by wage differentials across hospitals, are removed. Leveled costs per admission are calculated by multiplying the full cost per admission by a wage equalization factor, calculated by the NJDOH.

Our analyses are conducted with data that include both inlier and outlier admissions and with data that include only inlier admissions. Because outlier admissions are considered to have substantially different resource requirements, the DRG payment rate does not apply to

[1]Because data from several small multihospital systems are combined into a single hospital code, the actual number of hospital observations in the data set is 90.

such admissions. Instead, payment is based on controlled charges, which are designed to reflect hospital costs.

New Jersey defines seven categories of outliers: high length of stay, low length of stay, admitted and discharged on the same day, discharged against medical advice, died while in the hospital, low volume DRGs (number of admissions for a DRG are so low—fewer than five statewide—that a payment rate is not set), and clinical outliers (DRGs that are very heterogeneous, defined statistically by a large coefficient of variation, and for which no payment rate is set). Outlier admissions constituted close to 26 percent of total admissions in 1982.[2]

Methodology

The primary goal of this analysis was to determine whether patients with elective admissions experienced different average cost per admission than patients with emergency and urgent admissions. If such differences exist, to what extent are they due to differences in length of stay or cost per day? Furthermore, to what extent does the addition of admission status improve upon the ability of DRGs to explain variation in costs? To answer these questions, we tabulated descriptive statistics on the magnitude and distribution of the different types of admissions, and we estimated several multiple regression equations of cost per admission, LOS, and cost per day on one or more of the following explanatory variables: DRG, admission status, and hospital teaching status. The inclusion of DRG and hospital teaching status reflects the key parameters on which payment rates are based under the New Jersey system.

Two sets of regressions were run, using patient-level data. One set, executed on a 20 percent sample of patients in the 100 highest volume DRGs, was designed to estimate an aggregate effect of admission status (averaged over patients in all of the top 100 DRGs). The second set was designed to estimate a DRG-specific effect, by measuring the effect of admission status separately for each of 463 DRGs, using a 100 percent sample of inlier patients.[3]

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[2]The New Jersey program defines outliers differently than Medicare does in its DRG-based PPS program. Medicare recognizes high-cost outliers and high length-of-stay outliers. However, its criteria are such that a smaller proportion of admissions are classified as outliers than in New Jersey. The state had a Medicare waiver in 1982, so that the Medicare program reimbursed hospitals according to the state's rules rather than its own.

[3]Four DRGs were omitted because they had very few admissions.

The regressions on aggregate data were estimated twice, once using all admissions (both inliers and outliers) in the 20 percent sample of the top 100 DRGs and then using only inlier admissions. Regression analyses were run on inlier admissions because DRG payment rates are calculated for inlier patients only. The 100 highest volume DRGs accounted for 71 percent of inlier admissions. Table 5.1 compares the proportion of elective, medical, and surgical admissions between the top 100 DRGs and all 468 DRGs. The proportions are similar between the two groups.

Model Specification

Because the distribution of costs and LOS is skewed, the dependent variables were transformed by taking the natural logarithm of each.[4] In turn, the functional form of the estimated equations is log-linear. This implies the following relationship between the dependent variable (Y) and the explanatory variables ($X_1, \ldots, X_n$):

$$Y = exp(b_0 + b_1X_1 + \cdots + b_nX_n)\ exp(\epsilon)$$

Taking the natural logarithm of both sides of this equation, we get the log-linear form:

$$ln(y) = b_0 + b_1X_1 + \cdots + b_nX_n + \epsilon$$

Table 5.1

ELECTIVE, MEDICAL, AND SURGICAL ADMISSIONS FOR ALL DRGS COMPARED WITH THE 100 HIGHEST VOLUME DRGS, 20 PERCENT SAMPLE, NEW JERSEY, 1982

Group	No. of Inlier Admissions	Percent Elective	Percent Medical	Percent Surgical
All DRGs	177,330	47.3	59.9	30.3
100 highest volume DRGs	125,925 (71%)	49.9	61.2	26.0

SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

[4]Observations with either costs or LOS equal to zero were dropped from the analysis.

Variable Definition

In the aggregate regressions, a separate dichotomous variable was used to control for each DRG. Each DRG variable takes on a value of 1 for patients categorized into the corresponding DRG and 0 otherwise.

Both the aggregate and DRG-specific regressions control for teaching status. MAJTEACH equals 1 for patients admitted to a major teaching hospital and 0 otherwise. Similarly, MINTEACH equals 1 for patients treated at a minor teaching hospital and 0 otherwise. The omitted category is nonteaching hospitals.[5]

Patients' admission status is represented by the dichotomous variable ELECTIVE, which equals 1 for patients admitted on an elective basis, and 0 for patients with an emergency or urgent admission. In one set of aggregate regressions, elective medical and elective surgical DRGs are controlled for separately by the inclusion of two dichotomous variables, ELECMED and ELECSURG.[6]

Definition of Admission Status

According to the NJDOH guidelines, admissions fall into one of three categories: elective, urgent, and emergency. Admission status is coded by the admitting physician at the time of admission. Criteria for coding admissions may vary across hospitals, since they are not required to adhere to the NJDOH definitions. Consistency across hospitals may be partially enforced by payors. For instance, the Medicaid regulations for classifying patients are the same as the NJDOH guidelines. Moreover, Medicare requires prior authorization for elective admissions. Enforcement of this requirement presumably means that hospitals are encouraged to adhere to a uniform definition of elective admissions.

The NJDOH defines the three categories of admission status as follows:

- **Elective admissions** are scheduled or routine admissions, in which there is no urgency for immediate or very early medical evaluation or treatment because the possibility of serious consequences resulting from lack of treatment is small. The elective status of an admission does not mean that there is no medical need for the admission. It merely means that it is deferrable

[5]The coefficient of a dichotomous variable in a log-linear regression can be transformed into a measure of the percentage difference between the identified group and the omitted group. The transformation is $exp(b) - 1$, where b is the estimated coefficient.

[6]Each DRG is classified as medical (256 DRGs), surgical (193), or other (14).

and can, therefore, be scheduled. Uncomplicated pregnancies and all newborns are classified as elective.

- **Urgent admissions** may involve medical conditions or acute trauma such that medical attention, while not immediately essential, should be provided very early to prevent possible loss or impairment of life, limb, or body function. They include those cases where early evaluation or treatment is necessary because the patient has either serious disease or injury or symptoms of such disease or injury.
- **Emergency admissions** refer to acute trauma or medical conditions in which life, limb, or the function of patients depends on the immediacy of medical treatment. A patient does not have to be admitted through the emergency room to be considered an emergency admission. Conversely, not all patients admitted through the emergency room are classified as emergent admissions.

Even though uniform guidelines categorizing admission status were recommended by the state, we were uncertain of the extent to which hospitals and physicians interpreted these guidelines in a consistent manner. To determine the adherence of admissions coding to the state's definitions, we selected the 100 highest volume DRGs and sorted them by the percentage of inlier admissions that were elective. We then examined the DRGs that fell into each range of the distribution to verify that the coding of admission status made clinical sense. The coding appeared to reflect what one would expect to see clinically. Procedures such as rhinoplasty and tonsillectomy had a high proportion of elective admissions, whereas acute conditions, such as drug overdose and myocardial infarction, had a low proportion. Other DRGs, which consist of a less homogeneous group of principal diagnoses, have a more balanced proportion of elective, urgent, and emergency admissions.

A related problem is whether patients admitted on an urgent basis should be considered a separate category or grouped with emergency admissions or elective admissions. To examine this, we conducted additional regression analyses that included separate variables for patients admitted as urgent and those admitted on an elective basis. The results revealed that patients admitted as urgent had similar costs to patients admitted on an emergency basis. We, therefore, group emergency and urgent admissions together and report only the results using the ELECTIVE variable to represent admission status.

Aggregate Regressions

In the aggregate regressions, two different equations were estimated for cost per admission. First, cost per admission was regressed on patients' DRG classification, MINTEACH, MAJTEACH, and ELECTIVE. This specification permits an assessment of the following question: After controlling for all the factors included in the New Jersey rate-setting system, how do the costs of patients with elective admissions differ from those of patients with emergency and urgent admissions?

Since elective medical and elective surgical admissions may offer different opportunities in the ability to substitute outpatient services for inpatient services, the effect of elective admissions may differ between medical and surgical DRGs. Thus, in the second specification, cost per admission was regressed on patients' DRG classification, MINTEACH, MAJTEACH, ELECMED, and ELECSURG.

Assuming that the costs of elective and emergency/urgent admissions are significantly different, an important question is whether the inclusion of a single admission status variable (covering all DRGs) improves upon the DRG classification system's ability to explain variation in costs. Or, is the effect of admission status so different across DRGs that a separate adjustment factor is needed for each DRG? This issue was addressed by estimating two additional aggregate equations. Cost per admission was first regressed solely on patients' DRG classification, and, then, on DRG classification and admission status (ELECTIVE). Next, the adjusted R^2 values from these two equations were compared. An additional comparison was made to the equation that included teaching status (MINTEACH, MAJTEACH), DRG, and ELECTIVE as independent variables.

To test whether our model omits important correlates of admission status, we ran two regressions of cost per admission on a larger set of explanatory variables. The first consisted of additional variables for hospital location, hospital size (total admissions and total admissions squared), and patient age and sex. The second equation adjusted for all hospital-specific fixed effects by including a dummy variable for all but one hospital. It also included dummy variables for patient age, sex, and payment source. The inclusion of these additional variables resulted in no significant change in the effect of admission status. Therefore, we report only the results of analyses using DRG, hospital teaching status, and admission status as explanatory variables.

Differences in cost per admission, between elective and emergency/urgent admissions, can be decomposed into differences in LOS and cost per day. To determine the contribution of LOS and cost

per day to differences in cost per admission, the two variables were each regressed on DRG classification, MINTEACH, MAJTEACH, and admission status (either ELECTIVE or ELECMED and ELECSURG).

DRG-Specific Regressions

The issue of whether a separate adjustment factor is needed for each DRG was also explored by the execution of separate regressions for each of 463 DRGs. In these equations, cost per admission was regressed on MINTEACH, MAJTEACH, and ELECTIVE. This set of regressions permits an assessment of whether the effect of admission status is in the same direction and of similar magnitude for all DRGs or whether it varies by DRG. These regressions were run using only inlier patients. To test for omitted variable bias, we selected a subset of DRGs and ran regressions that included variables for hospital location and patient age and sex as well as teaching status and admission status. Again, because the results were not substantially different in the more expanded models, we report only the results for the first model.

EMPIRICAL RESULTS

The 20 percent sample of hospital admissions, used to conduct the aggregate regression analyses, contained 239,411 admissions, of which nearly one-half were elective. Table 5.2 shows the number of admissions and the proportion of emergency, urgent, and elective admissions for all admissions, inliers only, and outliers. Approximately 74 percent of the admissions were inliers, of which 35.0 percent were admitted on an emergency basis, 16.9 were urgent, and 47.3 percent were elective.

A relatively high proportion (75 percent) of low length-of-stay outliers were admitted on an elective basis, and a much smaller proportion (29 percent) of high length-of-stay outliers were elective. This association between outlier status and admission status could be attributable to two factors: Elective admissions may enable physicians to more efficiently plan resource use, thus potentially reducing the length of stay and increasing the likelihood that such admissions will have unusually low lengths of stay; on the other hand, patients who become high length-of-stay outliers may have a greater severity of illness.

Table 5.2

PROPORTION OF EMERGENCY, URGENT, AND ELECTIVE ADMISSIONS, NEW JERSEY, 1982

Category of Patients	No. of Admissions	% Emergency	% Urgent	% Elective
Inliers and outliers	239,411	34.2	16.1	48.9
Inliers	177,330	35.0	16.9	47.3
Low LOS outliers	34,693	17.0	7.7	74.6
High LOS outliers	18,574	48.8	21.3	28.9
Other outliers	4,963	47.9	21.0	30.2

SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

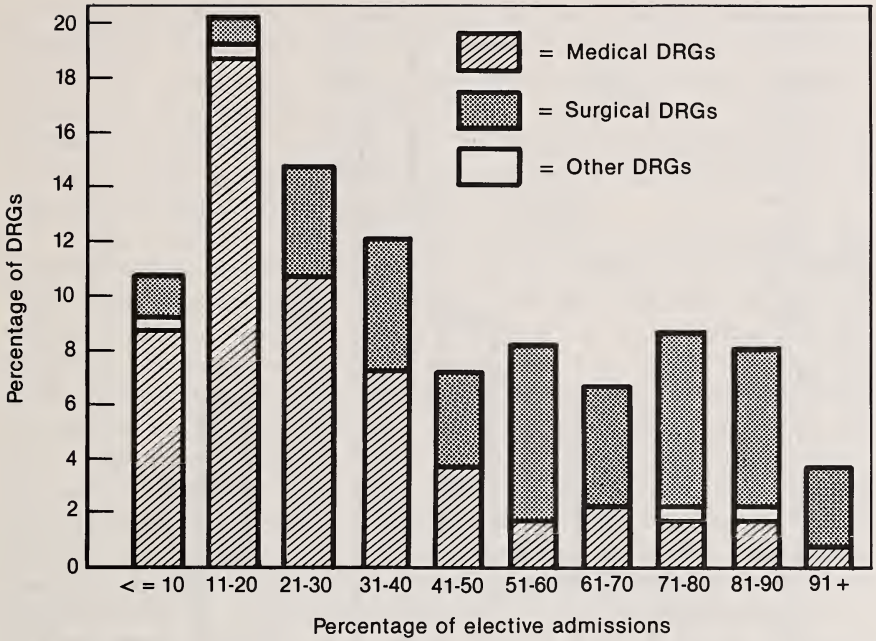
Distribution of Elective Admissions

Before discussing the regression results, we first examine the distribution of elective admissions by DRG, by hospital and hospital type, and by payor. Figure 5.1 shows the distribution of DRGs by the percentage of admissions (both inlier and outlier) that are elective within each DRG. As one would expect, there is a wide variation in the proportion of elective admissions within DRGs. Fewer than 10 percent of admissions are elective in 10 percent of the 467 DRGs. At the other extreme, over 90 percent of admissions are elective in 4 percent of the DRGs.

With respect to the association between admission status and average costs and the implications for the fairness of the payment system, the DRGs at the extreme ends of this distribution are of less concern. Since these DRGs are fairly homogeneous with respect to admission status, rates for these DRGs are based on either a relatively low or high percentage of elective admissions. However, DRGs in the middle of the distribution are much more heterogeneous with respect to admission status. If admission status is a predictor of costs, and emergency and urgent admissions are more costly, then the payment system may create incentives to discourage these nonelective admissions.

Figure 5.1 also compares the distribution of elective admission status by medical and surgical DRG categories. The proportion of elective admissions clearly differs between surgical and medical DRGs. Surgical DRGs tend to have a much higher proportion of such admissions.

Distribution of Elective Admissions Across Hospitals. If hospitals do not have a relatively equal proportion of elective admissions



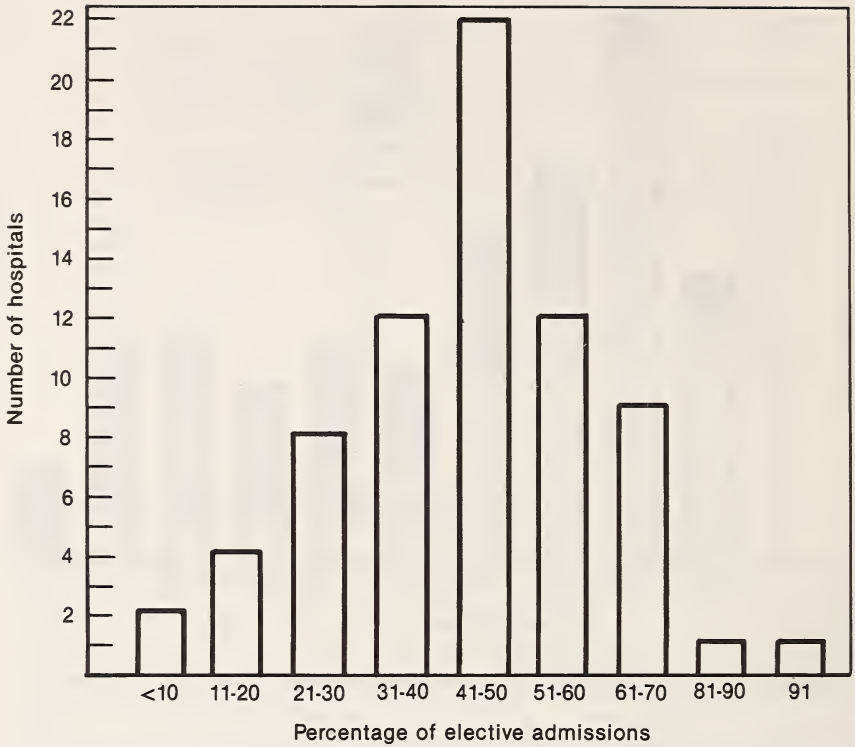
SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

Fig. 5.1.—Distribution of DRGs by percentage of elective admissions, New Jersey, 1982

and if elective admissions are associated with lower costs, then hospitals with a higher proportion of elective admissions may experience a financial windfall, whereas hospitals with a lower proportion of such admissions may suffer financial losses.

Figure 5.2 shows the distribution of hospitals by the percentage of elective (inlier and outlier) admissions. In the largest group of hospitals, elective admissions constitute between 41 to 50 percent of admissions. However, in more than one-third of hospitals, elective admissions constitute less than 40 percent of total admissions.[7]

[7]The data for hospitals at the extreme ends of the distribution should be interpreted somewhat cautiously, since the results may be due to differences in how these few hospitals code admission status.



SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

Fig. 5.2.—Distribution of hospitals by percentage of elective admissions, New Jersey, 1982

There are two possible explanations for a hospital having a lower than average proportion of elective admissions. It may have fewer admissions in DRGs that tend to have a high proportion of elective admissions, such as rhinoplasty or tonsillectomy (but in the few admissions in these DRGs, the proportion of elective admissions is the same as in other hospitals). Or it may have fewer elective admissions within each individual DRG. The two explanations do not carry the same distributional implications. It is only with the second factor that we need

be concerned about the financial consequences of having fewer elective admissions. In the first case, the hospital's reimbursement level for each DRG presumably reflects resource use, since it has a proportionate share of elective admissions within each DRG. It merely has a different distribution of DRGs. In the second case, resource use may exceed average reimbursement levels because a higher proportion of admissions within DRGs are emergent or urgent.

To determine the characteristics of hospitals that could account for the differences in the distribution of elective admissions, we examined differences by teaching status and by location. Hospitals are categorized as major teaching, minor teaching, or nonteaching by the NJDOH. Nonteaching hospitals account for over half of the hospital admissions in the state (54 percent), major teaching hospitals account for almost one-third (31 percent), and minor teaching hospitals account for 15 percent. Table 5.3 shows the proportion of elective admissions in each of the three types of hospitals. Even though major teaching facilities are expected to serve a more severe case mix, the proportion of elective admissions is very similar to that of nonteaching and minor teaching hospitals. Apparently, teaching status does little to explain differences in the proportion of elective admissions among hospitals.

A hospital's location is expected to influence the nature of admissions within a hospital. For example, locating hospitals in rural areas

Table 5.3

PERCENTAGE OF ELECTIVE ADMISSIONS BY HOSPITAL TEACHING STATUS AND LOCATION, NEW JERSEY, 1982

Hospital Type	Inliers and Outliers	Inliers Only	Percent of Total Admissions
Teaching status			
Nonteaching	49.0	46.8	54
Minor teaching	50.5	49.5	31
Major teaching	46.2	45.1	15
Location			
Inner city	40.8	39.2	37
Urban	49.3	48.0	28
Suburban	58.0	52.6	26
Rural	40.5	39.6	9

SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

is often justified because residents of outlying areas need emergency care; such hospitals might be expected to have a higher proportion of emergency admissions than suburban hospitals. Inner-city hospitals may also be expected to have a higher proportion of emergency admissions. Suburban hospitals account for 37 percent of the admissions in the state, urban 28 percent, inner-city 26 percent, and rural 9 percent. Table 5.3 shows the distribution of elective admissions by the location of hospitals.

There is a pronounced difference in the proportion of elective admissions by location. Rural and inner-city hospitals have the lowest proportion of elective admissions and suburban hospitals have the highest proportion.

Distribution of Elective Admissions Across Payors. We also examined the distribution of elective admissions across payors. The major payor categories include: Blue Cross and commercial insurers, Medicare, Medicaid, self-pay patients, and other patients (including enrollees in HMOs, individuals covered by Title V—a government program for maternal and child health care, Workers' Compensation, and no fault automobile insurance). Because admissions for routine pregnancies and newborn infants are considered elective and because these types of admissions are not distributed uniformly across all payors (a high proportion of Medicaid admissions consist of such patients), we examined the distribution of (inlier and outlier) admissions for all DRGs and for the set of DRGs that excludes DRGs associated with routine pregnancy. Table 5.4 shows that Medicaid and self-pay patients have a much lower proportion of elective admissions than other payors, once routine pregnancies are removed.

Regression Results

Aggregate regression results for the top 100 DRGs are presented in Table 5.5. The three dependent variables (cost per admission, cost per day, and LOS) are regressed on the teaching status of the hospital and the patient's DRG category[8] and admission status. The top panel reports results from regressions based on all patients (both inliers and outliers), and the bottom panel reports results based only on inlier patients. A significant, negative association exists between elective admissions and cost per admission, for both all and inlier admissions. Transforming the ELECTIVE coefficients reveals that after controlling for DRG and hospital teaching status, elective admissions are 18.0

[8]The coefficients of the 99 dichotomous variables used to control for DRG are not reported.

Table 5.4

PERCENTAGE OF ELECTIVE ADMISSIONS BY PAYOR, NEW JERSEY, 1982

Payor	All DRGs	Nonpregnancy Related DRGs	Percent of Total Admissions
Blue Cross and commercial	56.3	46.6	48.5
Medicare	33.6	33.6	27.5
Medicaid	41.0	28.9	10.3
Self pay	37.6	21.8	7.1
Other	49.7	42.5	6.6

SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

percent less expensive on average than emergency/urgent admissions when the comparison is made over all patients, and 6.5 percent less expensive when the comparison is made over inliers.[9] The effect of elective admissions is larger, in absolute value, for all patients because short-stay outliers (who tend to have lower costs per admission compared to other patients in the same DRG) have a disproportionate share of elective admissions (75 percent), and long-stay outliers (who tend to have higher costs) have a disproportionate share of emergency and urgent admissions (69 percent).

The negative association between cost per admission and elective status is the consequence of a shorter average LOS in the inlier and outlier sample. However, in the inlier sample, the lower cost per admission associated with elective admissions is due both to a shorter average LOS and to lower cost per day. For the comparison made across all patients, elective admissions have an average LOS that is 18.5 percent shorter (after transforming the regression coefficient) and an average cost per day that is 0.6 percent greater than emergency/urgent admissions. For the inlier sample, the average LOS is 3.4 percent shorter for elective admissions, and the average cost per day is 3.1 percent lower. Therefore, lower costs per admission stem from nearly equal reductions in LOS and cost per day for inlier admissions, but only from reductions in LOS for all (inlier and outlier) admissions.

[9]Because ELECTIVE is a dichotomous variable, the regression coefficients reported in the table were transformed by $exp(b) - 1$ to get the percentage difference between elective and emergency/urgent admissions.

Table 5.5

REGRESSION RESULTS: EFFECTS OF ADMISSION STATUS ON HOSPITAL COST[a] AND LENGTH OF STAY FOR THE TOP 100 DRGS, 20 PERCENT SAMPLE, NEW JERSEY, 1982

Dependent Variable	Major Teaching Hospital	Minor Teaching Hospital	Elective Admission	R^2	F	N
			Inliers and Outliers			
Cost per admission	0.104*	0.004	−0.198*	0.499	1555	159133
	(0.003)	(0.004)	(0.004)			
Length of stay	0.037*	0.003	−0.205*	0.521	1696	159168
	(0.003)	(0.004)	(0.004)			
Cost per day	0.067*	0.002	0.006*	0.459	1323	159133
	(0.002)	(0.002)	(0.002)			
			Inliers			
Cost per admission	0.087*	0.019*	−0.067*	0.622	2007	124341
	(0.003)	(0.003)	(0.003)			
Length of stay	0.008*	−0.005**	−0.035*	0.654	2299	124342
	(0.002)	(0.003)	(0.002)			
Cost per day	0.079*	0.024*	−0.032*	0.546	1467	124341
	(0.002)	(0.002)	(0.002)			

SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

NOTE: Standard errors are presented within parentheses.

[a]Hospital costs are adjusted for differences in input prices.

*Significant at p = 0.01.

**Significant at p = 0.05.

Table 5.6 reports results from the regression of the three dependent variables on DRG classification, hospital teaching status, and separate dichotomous variables for elective medical and elective surgical admissions. It contains the coefficients for ELECMED and ELECSURG and repeats the ELECTIVE coefficients from the bottom panel of Table 5.5. These equations were estimated using the inlier sample. A comparison of the ELECMED and ELECSURG coefficients for the cost per admission equation reveals that the savings of elective surgical admissions are twice as large as the savings of elective medical admissions. Transforming the coefficients reveals that elective surgical admissions are 10.2 percent less costly on average than

Table 5.6

REGRESSION RESULTS: EFFECTS OF ADMISSION STATUS ON HOSPITAL COST[a] AND LENGTH OF STAY FOR MEDICAL AND SURGICAL DRGS, NEW JERSEY, 1982

Dependent Variable	Elective Admission	Elective Medical Admission	Elective Surgical Admission
Cost per admission	−0.067*	−0.050*	−0.108*
	(0.003)	(0.004)	(0.006)
Length of stay	−0.035*	−0.017*	−0.088*
	(0.002)	(0.003)	(0.003)
Cost per day	−0.032*	−0.033*	−0.020*
	(0.002)	(0.002)	(0.004)

SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

NOTE: The data consist of a 20 percent sample of inlier patients in the top 100 DRGs. Standard errors are presented within parentheses.

[a]Hospital costs are adjusted for differences in input prices.

*Significant at p = 0.01.

**Significant at p = 0.05.

emergency/urgent admissions, but elective medical admissions are only 4.9 percent less costly than emergency/urgent admissions. Furthermore, for surgical DRGs, 82 percent of the lower cost of elective admissions is attributable to a shorter LOS, but for medical DRGs, 65 percent of the lower cost is due to lower average cost per day.

The results presented in Tables 5.5 and 5.6 indicate that averaging across DRGs, elective admissions are substantially less expensive than emergency/urgent admissions. Still unanswered, however, is the question of whether the addition of admission status improves upon the ability of DRGs to explain variation in cost per admission. The results presented in Table 5.7 address this question.

Table 5.7 summarizes the regression of cost per admission on three different specifications: (1) DRGs only, (2) DRGs and ELECTIVE, and (3) DRGs, ELECTIVE, MINTEACH, and MAJTEACH. These equations were estimated using both the inlier and outlier sample and the inlier sample.[10] The result of particular importance is the almost identical values of the adjusted R^2 from each equation. It ranges from

[10]The coefficients on the 99 DRG dichotomous variables are not reported.

Table 5.7

INCREMENTAL REDUCTION IN UNEXPLAINED VARIATION ACHIEVED BY ADDING ADMISSION STATUS AS AN EXPLANATORY VARIABLE IN ESTIMATING COST PER ADMISSION[a]

Model	Major Teaching Hospital	Minor Teaching Hospital	Elective Admission	Adjusted R^2	F	N
			Inliers and Outliers			
(1) DRG				0.487	1524	159133
(2) DRG +			-0.209* (0.005)	0.496	1565	159133
(3) DRG +	0.104* (0.003)	0.004 (0.004)	-0.198* (0.004)	0.499	1555	159133
			Inliers			
(1) DRG				0.617	2022	124341
(2) DRG +			-0.075* (0.003)	0.619	2017	124341
(3) DRG +	0.087* (0.003)	0.019* (0.003)	-0.067* (0.003)	0.622	2007	124341

SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

NOTE: Standard errors are presented within parentheses.

[a]Hospital costs are adjusted for differences in input prices.

*Significant at p = 0.01

0.487 to 0.499 for the inlier and outlier sample and from 0.617 to 0.622 for the inlier sample. The addition of a single adjustment factor for admission status (i.e., one that is constant for each DRG) adds almost nothing to the DRG classification system's ability to explain variation in cost per admission.[11] The implication of this result is that when averaged across all DRGs, elective admissions are less costly than emergency and urgent admissions, but the impact of admission status varies substantially across DRGs. To understand the magnitude of this variation, we now turn to the DRG-specific regression results.

The distribution of the ELECTIVE coefficients from the 463 DRG-

[11]A similar comparison using the adjusted R^2 from a regression of cost per admission on DRG classification, ELECMED, and ELECSURG yielded the same result. Therefore, the inclusion of separate elective admission adjustment factors for medical and surgical DRGs also does not increase the explanatory power of DRGs.

Table 5.8

DRG-SPECIFIC REGRESSIONS: DISTRIBUTION OF ELECTIVE ADMISSION COEFFICIENTS

	All DRGs		Medical DRGs		Surgical DRGs	
Value of Coefficient	No.	%	No.	%	No.	%
< −0.40	12	(2.6)	4	(1.6)	6	(3.1)
−0.40 – −0.31	17	(3.7)	3	(1.2)	14	(7.2)
−0.30 – −0.21	65	(14.0)	29	(11.3)	36	(18.6)
−0.20 – −0.11	122	(26.3)	50	(19.5)	67	(34.7)
−0.10 – −0.01	151	(32.6)	103	(40.2)	45	(23.3)
0 – 0.09	69	(14.9)	51	(19.9)	16	(8.3)
0.10 – 0.19	17	(3.7)	12	(4.7)	5	(2.6)
0.20 – 0.29	6	(1.3)	1	(0.4)	4	(2.1)
≥ 0.30	4	(0.8)	3	(1.2)	0	(0.0)

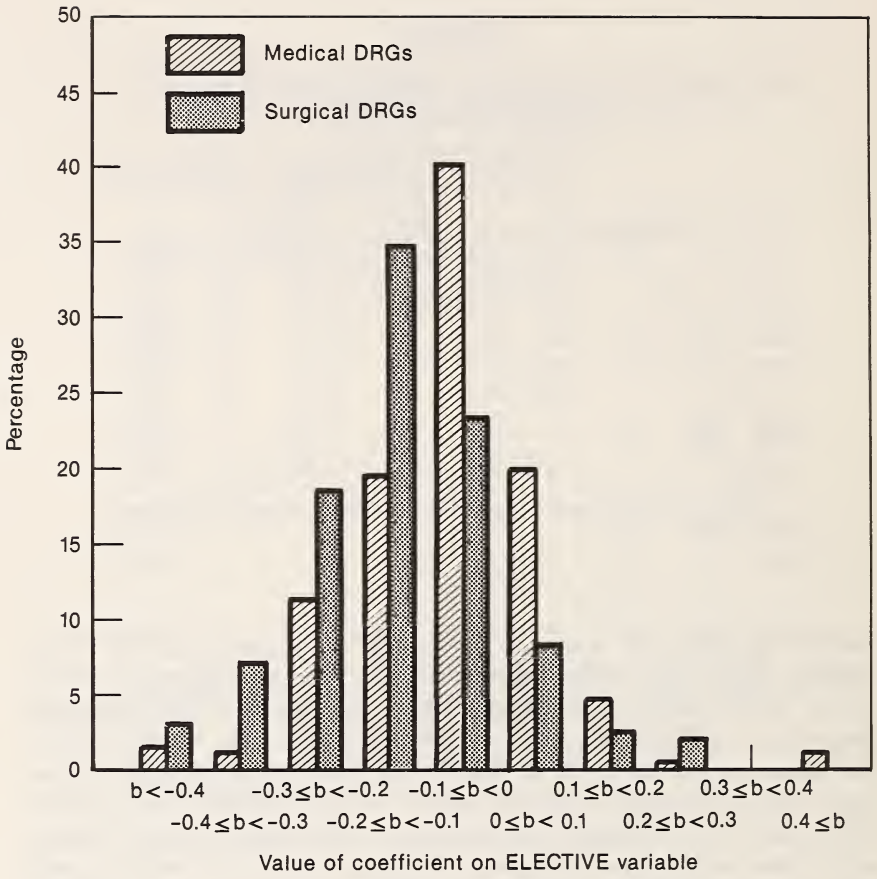
SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

specific regressions is shown in Table 5.8.[12] The results of the DRG-specific regressions verify that the effect of elective admissions varies widely across DRGs. For medical DRGs, the values of the coefficient range from −0.974 (DRG 317) to 0.519 (DRG 462). For surgical DRGs, the values range from −0.783 (DRG 271) to 0.296 (DRG 153). However, nearly 75 percent of all the values for the coefficient fall between −0.20 and 0.10. Although the aggregate relationship between elective admissions and cost per admission is negative, there is a positive association in 13 percent of surgical DRGs and 26 percent of medical DRGs.

Figure 5.3 portrays the distribution of the estimated coefficient for the regression of admission status on cost per case for the 256 medical DRGs and the 193 surgical DRGs.[13] From the perspective of setting reimbursement policy, one may be willing to overlook "small" differences in costs but would want to take into account "large" differences. For illustrative purposes, assume that a ±5 percent difference in cost is too small to be of concern. By this standard, 65 percent (166) of the medical DRGs and 85 percent (164) of the surgical DRGs are of concern.

[12]Four of the 467 DRGs were omitted because they had very few admissions.

[13]Fourteen of the 463 DRGs used for DRG-specific regressions are classified as "other."



SOURCE: New Jersey Department of Health, Hospital Discharge Data, 1982.

Fig. 5.3.—Distribution of ELECTIVE coefficients for medical and surgical DRGs

VI. SUMMARY AND CONCLUSIONS

In this section of the report we summarize our empirical results pertaining to the effects of New Jersey's all-payor DRG-based rate-setting program and discuss their implications.

HOSPITAL RESPONSES TO THE ECONOMIC INCENTIVES

A primary incentive of the DRG-based rate-setting program is to reduce the average cost per case. This can be accomplished by reducing average length of stay and/or average cost per day of patients admitted to the hospital. Our findings indicate that hospitals responded to these incentives. They lowered average length of stay by 3.1 percent and average cost per adjusted patient day by 2.9 percent. These results reveal that hospitals were able to reduce the number of days a patient spent in the hospital as well as the intensity of resource use during these shorter stays.

Hospitals were able to lower the cost per day of care, despite treating patients in fewer days, by reducing labor expenses. If hospitals were able to lower lengths of stay while holding labor expenses constant, we would expect to see labor expense per adjusted admission fall by approximately the same proportion as the reduction in length of stay, 3.0 percent. However, labor expense per adjusted admission fell by 4.7 percent. This difference is accounted for by the estimated reduction in labor expense per adjusted patient day, 1.4 percent. The source of these savings appears to have come from reduced staffing rather than substitution of less expensive personnel. The number of FTE RNs per bed was unaffected by the DRG rate-setting program, whereas the number of FTE LPNs, who are less expensive than RNs, fell by an estimated 4.7 percent.

Despite all this apparent evidence of improved economy, why did the DRG program not generate any overall savings for hospital inpatient care? The answer to this question lies in our findings of increased total admissions. There are several possible explanations for the increase in the number of inpatient admissions.

Under the DRG program, hospitals are paid a fixed amount regardless of the costs incurred in treating a patient. The DRG payment rate is based partially on the average cost across a group of hospitals and partially on the average cost within the hospital. As long as marginal costs are lower than average costs, a hospital with excess capacity can increase its profit margin by admitting more patients.

A related explanation concerns the unbundling of admissions. If a patient has multiple problems, the DRG program provides an incentive to treat each illness in a separate admission, thus generating additional admissions. If either explanation underlies the observed behavior in the New Jersey DRG program, then the structure of the program has a serious flaw that undermines its cost control potential.

An alternative explanation for the observed increase in total admissions has been offered. This explanation concerns the program's policy to reimburse hospitals for charity care and bad debt expenses. It has been suggested that the introduction of payments for uncompensated care expenses resulted in an increase in admissions to meet previously unmet need among the uninsured population.

We conducted some analyses regarding the timing of the effects of the DRG program to assess this hypothesis. First, we examined differences in the effects of the DRG program in terms of when hospitals entered the program. We found very little difference in the DRG effects between hospitals that entered the program in different years. Those that went on DRGs in fiscal years 1980, 1982, and 1983 increased admissions by 5.0–6.0 percent. Hospitals entering the system in 1981 had a slightly smaller increase in admissions. Next, we looked at the effects of "length of time on the program" on total admissions. If there were a surge in admissions due to unmet need, one would expect increases in admissions to decline with the length of time on the program. Our findings, however, reveal a trend where the rate of increase in admissions increases the longer the hospital is on the program. Thus, it appears that the DRG program suffers from the same weakness as non-DRG, per case prospective payment programs—an incentive to increase admissions.

DO HOSPITALS ALTER THE PAYOR MIX OF THEIR ADMISSIONS?

Using patient-level regression analyses and controlling for DRG and hospital teaching status, we found that Medicare patients consume more resources than privately insured patients. However, because of the structure of the rate-setting methodology and other features of the New Jersey system, differences in profitability between Medicare and non-Medicare patients were not as great as differences in resource use. We identified a subset of DRGs in which over one-half of Medicare patients were expected to incur financial losses and in which non-Medicare patients generated financial surpluses if treatment patterns remained the same as in 1979.

Using the selected DRGs, we examined changes in the concentration of Medicare patients across hospitals before and after introduction of the DRG program. We found no widespread changes in access to care on the part of Medicare patients at the statewide level. This finding suggests that hospitals did not limit admissions of Medicare patients in these DRGs on a widespread basis.

In interpreting the findings, it is important to note that our data cover only the first three years of the DRG program in New Jersey and thus reflect only the early stages of hospital adjustment to the implementation of the system. It may be that as hospitals adjust to the rate-setting system, their responses will become more extreme and may include activities such as dumping.

Our inability to observe patient dumping at a statewide level may be due to one or more alternative reasons. It may simply be that hospitals have not responded to DRGs by dumping patients. It may be that our analysis, which focused solely on payor class, should have included other patient characteristics, such as age and co-morbidity. It may be that patient dumping is not a widespread practice in New Jersey, but is practiced by only a few hospitals. If this is the case, our statewide analysis may have not been able to detect small-scale dumping activities. On the other hand, dumping may be practiced by hospitals, but their efforts to do so cancel each other out, so that we do not detect any changes in the concentration of Medicare patients.

Medicare patients constitute such a large share of hospitals' revenues that hospitals may be reluctant to limit admissions within a DRG solely on the basis of Medicare status. The Medicare population is not an entirely homogeneous population, in that many beneficiaries are relatively healthy, and others are frail. Studies of the elderly population (over 65 years of age) increasingly subdivide it into a young-old (65–75) and an old-old group (over 75 or older in some studies). Hospitals concerned about patient mix may focus on characteristics such as age, frailty, or comorbidities, instead of simply Medicare status. A more refined analysis that includes these characteristics as well as payor status may be more revealing.

To minimize hospital opposition to the all-payor, rate-setting system, the New Jersey Department of Health was said to have been somewhat generous in setting payment rates and outlier rules during the early years of the program. The generosity of the rates and the provisions for meeting the full financial requirements of hospitals may have provided sufficient support that hospitals did not feel compelled to resort to extreme behavior such as patient dumping. It has been only recently that the state has been said to be tightening its hospital payment provisions. It is unclear whether hospitals will seek to limit

access of patients as the state's payment policy becomes more stringent.

SHOULD EMERGENCY ADMISSIONS HAVE HIGHER PAYMENT RATES?

The analyses show that in the aggregate, elective admissions are less expensive on average than emergency and urgent admissions, after controlling for DRG and hospital teaching status. This difference is more pronounced in surgical DRGs. However, our analysis of individual DRGs shows that the effect is not the same for each DRG. Thus, including a single adjustor for admission status does not improve the ability of the DRG system to explain variation in hospital cost per case. Although for most DRGs elective admissions have a lower average cost per case than emergency and urgent admissions, in 26 percent of medical DRGs and 13 percent of surgical DRGs elective admissions incur a higher average cost per case.

Even though emergency and urgent admissions are found to have higher average costs after controlling for case mix, the desirability of including an admission status variable in a DRG-based reimbursement system is debatable. First, inclusion of a single adjustor does little to reduce unexplained variation in cost per admission after controlling for DRG. Second, the incentives of such an adjustor are problematic.

Ideally, one would want to base reimbursement rates on objective clinical characteristics of patients that are less amenable to provider manipulation. Basing reimbursement on treatment decisions, provides an incentive to alter the course of treatment in such a way as to maximize reimbursement. If higher levels of reimbursement were set for emergency and urgent admissions, hospitals would have an incentive to classify admissions as emergency or urgent if at all possible. Because the coding of admission status is somewhat subjective, it could be subject to manipulation—the equivalent of DRG creep.

One option in developing an adjustor is to use clinical correlates of admission status that would adjust for severity level. Finding such correlates, however, may not be an easy task. Coulton et al. (1985) showed that for 10 of the 13 most prevalent DRGs in a medical intensive care unit (ICU), patients who spend some time in an ICU consumed more hospital resources than other patients who received only routine hospital care. But, including ICU use as an adjustor would pose the same problems as including admission status in that hospitals would have an incentive to shift patients to an ICU, at least for a portion of their hospital stay.

While the use of admission status to adjust hospital payment rates may not be feasible, the existing policy of not adjusting for admission status may be unfair to hospitals with a higher than average proportion of emergency admissions. The finding that even after controlling for DRG, emergency and urgent admissions have higher average costs than elective admissions points to a weakness in the DRG system that can potentially be exploited by providers.

Admission status is a variable that hospitals can easily identify. As such, it is an easy target for hospitals attempting to improve their bottom line. Hospitals can reduce the likelihood of emergency admissions by closing or downgrading their emergency rooms. To increase the proportion of elective admissions, they may develop or strengthen programs or services that cater to populations likely to be admitted on an elective basis. Because of these potential problems, further research into the role of admission status in a DRG-based reimbursement system is needed.

BIBLIOGRAPHY

Coulton, C. J., D. McClish, H. Doremus, S. Powell, S. Smookler, and D. Jackson, "Implications of DRG Payments for Medical Intensive Care," *Medical Care*, Vol. 23, No. 8, 1985, pp. 977–985.

Cretin, S., J. P. Newhouse, J. Buchanan, and C. Witsberger. *Accounting Profits by Diagnosis Related Group and by Hospital Type under Alternative Prospective Payment Methods,* The RAND Corporation, Santa Monica, California, unpublished draft, March 1986.

Dranove, D., and K. Cone, "Do State Rate Setting Regulations Really Lower Hospital Expenses?" *Journal of Health Economics*, Vol. 4, 1985, pp. 159–165.

Feder, J., et al., "How Did Medicare's Prospective Payment System Affect Hospitals?" *The New England Journal of Medicine,* Vol. 317, No. 14, October 1, 1987, pp. 867–873.

Frank, R. G., and J. R. Lave, "The Psychiatric DRGs: Are They Different?" *Medical Care*, Vol. 23, No. 10, October 1985, pp. 1148–1155.

Horn, S. D., R. A. Horn, and P. D. Sharkey, "The Severity of Illness Index as a Severity Adjustment to Diagnosis-Related Groups," *Health Care Financing Review,* 1984 Supplement, November 1984, pp. 33–45.

Hsiao, W. C., and D. L. Dunn, "The Impact of DRG Payment on New Jersey Hospitals," *Inquiry,* Vol. 24, Fall 1987, pp. 212–220.

Hsiao, W. C., et al., "Lessons of the New Jersey DRG Payment System," *Health Affairs,* Vol. 5, No. 2, Summer 1986, pp. 32–45.

May, J. J., and J. Wasserman, "Selected Results from an Evaluation of the New Jersey Diagnosis-Related Group System," *Health Services Research,* Vol. 19, No. 5, December 1984, pp. 547–559.

Mitchell, J. B., K. A. Calore, J. Cromwell, M. Freiman, and H. T. Hewes, *Creating DRG-Based Physician Reimbursement Schemes: A Conceptual and Empirical Analysis*, First Year Report to HCFA under Grant Number 18-P-98387/1–01, Center for Health Economics Research, Chestnut Hill, Massachusetts, October 1984.

Mitchell, J. B., K. A. Calore, J. Cromwell, M. Freiman, and H. T. Hewes, *Physician DRGs: What Do They Look Like and How Would They Work?* Draft Discussion Paper, HCFA Grant Number 18-P-98387/1–01, Center for Health Economics Research, Chestnut Hill, Massachusetts, February 1985.

Munoz, E., A. Laughlin, D. M. Regan, I. Teicher, I. B. Margolis, and L. Wise, "The Financial Effects of Emergency Department-Generated Admissions Under Prospective Payment Systems," *The Journal of the American Medical Association*, Vol. 254, No. 13, October 4, 1985, pp. 1763–1771.

Munoz, E., R. Soldano, A. Laughlin, I. B. Margolis, and L. Wise, "Source of Admission and Cost: Public Hospitals Face Financial Risk," *American Journal of Public Health*, Vol. 76, No. 6, June 1986, pp. 696–697.

Rosko, M. D., and R. W. Broyles, "The Impact of the New Jersey All-Payer DRG System," *Inquiry,* Vol. 23, Spring 1986, pp. 67–75.

Rosko, M. D., and R. W. Broyles, "Short-Term Responses of Hospitals to the DRG Prospective Pricing Mechanism in New Jersey," *Medical Care*, Vol. 25, No. 2, February 1987, pp. 88–99.

West, H., L. Marcus, P. McMenamin, and L. Guralnick, *Physician and Hospital Reimbursement Study*, HHS Contract No. 100–83–0026, Mandex, Inc., Vienna, Virginia, January 1985.

Worthman, L. G., and S. Cretin, *Review of the Literature on Diagnosis Related Groups,* The RAND Corporation, N-2492-HCFA, October 1986.